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ECOLOGY.—*Adaptive coloration in a single faunal association.*[1] THEODORE H. EATON, Jr., Cornell University. (Communicated by C. LEWIS GAZIN.)

The meaning and methods of adaptive coloration are stated so fully in Cott's recent book (1940) that a general survey of the subject may not be needed again for some years. Rather his work, with its large bibliography, should stimulate special studies and detailed applications of principles. One such problem that has not yet received adequate treatment is the effect of adaptive coloration on the total population of a single ecological association.

An association particularly favorable to such study is the rain forest of Barro Colorado Island in the Canal Zone, now receiving maintenance as a biological reservation from the United States Government. The writer collected there in the summer of 1939.

Barro Colorado Island, in Gatun Lake, is about 6 square miles in area, almost entirely covered by climax rain forest. Over 700 species of trees occur there, the dominant crowns of a few, such as *Bombacopsis felderi*, exceeding 200 feet in height. Most species are broad-leaved hardwoods. A litter of fallen leaves covers the ground nearly everywhere, averaging 1 to 4 inches in depth, but decomposition of this litter is so rapid that the red lateritic clay soil begins directly under it with scarcely any or humus layer. The undergrowth varies in density but in most places is not thick enough to interfere with walking. Although there is little standing water on the island, numerous small streams run down to the lake, their beds being generally of blackened pebbles and boulders.

Thus the niches available for the rain-forest fauna (apart from burrowing, subterranean or aquatic forms) are the following:

1. Trees: Foliage, limbs, trunks, crevices.
2. Epiphytic vegetation, including lianas, bromeliads, ferns, mosses, etc.
3. Undergrowth: Foliage, stems.
4. Ground surface, on or under leaf litter.
5. Ravines, stream beds, banks, bare trails, beaches (a relatively small area).

[1] Received February 15, 1941.

ECOLOGICAL RELATIONSHIPS OF THE TYPES OF COLOR ADAPTATION

I. Color adaptations among rain-forest animals are numerous and varied. Cott (1940) groups them as concealment, advertisement, and disguise. There is a strong correlation between adaptive appearance and the diurnal-nocturnal rhythm. Species that are quiet by day and active by night almost invariably show either concealment or disguise in some form, provided they spend the day in a place exposed to the view of animals that hunt by sight. Many species that are active by day, but that spend a part of that time at rest in such places, show the same thing when they are at rest. Species that mimic others exhibit this feature by day, although in some cases they are nocturnal as well. Warning, display, allure, or directive markings function by day, the species very frequently being active both day and night. Adaptive coloration apparently does not occur among animals that burrow or hide out of the ordinary field of vision. It is lacking, for instance, in certain moths (Pyralidae, Geometridae) and butterflies (Hesperiidae, Erycinidae) that alight regularly on the under sides of leaves, showing themselves only while in rapid flight. Thus adaptive coloration is limited to the species that might be visible by day, and, if seen, accessible, whether as prey or as predators.

II. Relationship between adaptive coloration and niches in the rain-forest association:

A. *Obliterative* or *procryptic* coloration occurs in species that rest or pause against a relatively homogeneous background, that is, one in which separate objects mean little or do not show. This must be interpreted in each case from the standpoint of a casual observer. The animal comes within the field of vision but is so colored that it is not noticed as an object. Backgrounds available for obliteratively colored species on Barro Colorado are these:

(1) Surfaces of green leaves. For obliterative effect any surface must be larger than the animals on it, i.e., sufficient to serve as a background. The eggs, larvae, and chrysalids of many Lepidoptera, the adults of some (Geometridae especially), many Coleoptera, Hemiptera, Homoptera, and Orthoptera, some spiders and some tree frogs are cryptically colored on green leaves.

(2) Foliage en masse. Certain larger animals show an obliterative green against the background of massed foliage, which from a distance can be regarded as homogeneous. Such are the green tree-snakes, lizards like *Polychrus gutturosus* and *Iguana iguana*, and many, if not all, of the green birds.

(3) Tree trunks, root buttresses, fallen logs. Procryptic animals here include Lepidoptera (Noctuidae, Notodontidae, Geometridae, Sphingidae, some nymphalid and brassolid butterflies), many caterpillars, Coleoptera such as cerambycids, elaterids, and some prionids, certain spiders, tree frogs, and geckos.

(4) Leaf litter, probably 99 per cent of the ground cover in the forest. Animals deceptively colored like this background include Lepidoptera (Noctuidae, Notodontidae, Geometridae, Satyridae, Nymphalidae, and others), some Orthoptera and spiders, many frogs, toads, lizards, and snakes, ground birds such as tinamous and (by day) nighthawks. Many of the Lepidoptera show a partial leaf-vein pattern on their wings, but the shape of the wings is usually not leaflike, since obliteration rather than object-imitation is the result achieved. Satyrid butterflies of the genus *Pierella* are common examples of this. While the leaf litter is relatively homogeneous as a background, enough contrast of light, shade, and sharp edges occurs to cause disruptive patterns frequently to accompany obliterative coloring in the species that occupy this niche.

(5) Bare ground, as mud beside streams, open trails, banks, etc. A dark purple-brown *Cicindela* is common and procryptically colored on the trails, so that only careful watching will detect it before it flies. The tendency of many species of tiger beetles to show the color of their background is familiar. Dice and Blossom (1937) recently pointed out that the same is true of local races of *Peromyscus* living in open, arid country, but is less likely to occur in covered areas.

B. *Disruptive pattern* is common in connection with obliterative background resemblance. Its effect is to add a seeming discontinuity to the procryptic effect already achieved. An excellent example, one among many in Lepidoptera, is the large, brown satyrid *Antirrhaea miltiades*, in which a white blotch and streak on the hind wings destroy any probable recognition of the butterfly as a separate object when it alights on dead leaves. The remainder of the pattern is dead-leaf brown. Most cases of deceptive rupture of pattern will probably be found to work when the rest of the pattern is obliterative and the background moderately heterogeneous. Accordingly the leaf-litter fauna should be, and is, particularly rich in this kind of adaptive coloration. Species on pebbly ground and on rough tree trunks often show it as well.

C. *Object resemblance.* Cott uses the term "disguise" to cover this and the usual mimicry between species. "Object resemblance" expresses somewhat more exactly the meaning of the present category.

This type of deception is found in niches occupied largely by discrete objects, such as leaves, twigs, or thorns. Species that resemble these objects do so by adaptation not only of color but of form. The disguise is most effective while the animal is motionless, except when the objects in question happen to move, in which case the animal may do so. Many of the amazingly twiglike Phasmidae (Orthoptera) sway rhythmically from side to side like twigs in a breeze. Certain Mantidae have also become twiglike. *Dinopis*, a spider, fits its legs together in line with the body and hangs motionless like a piece of dead twig on an inconspicuous thread. Among the twig-imitators should also go the spider that prepares a line of frass with a half-inch gap, into which it then fits and so completes the artificial twig. Twiglike geometrid larvae are common, as are the thornlike membracids. It is a rule that these types occur in places where the particular thorns or twigs they resemble also prevail.

Examples of leaf-imitation involving the color, pattern, and form of leaves are: Leaf-mantids (some resembling living, others dead leaves), leaf-butterflies, and a few large moths, like *Ophideres*, which hangs in a most convincing manner like a dead leaf from the stem of a low bush.

D. *Transparency*. It is, of course, impossible for a flying insect to achieve complete transparency, although many aquatic organisms, including prawns in Gatun Lake, have nearly or quite done so. Yet a filmy translucence affecting the larger part of the insect has a highly deceptive function. Sometimes it is combined with a contrasting pattern, as in some of the largest forest damselflies (Zygoptera, Coenagrionidae), where at the tip of each wing is a yellow, white, or blue spot, and the insect as a whole is difficult to see in flight because almost nothing shows but these separated, vibrating spots. Transparency has developed among butterflies in more than one shade-living group independently, the most important being Ithomiidae. *Ithomia*, *Leucothyris*, and some other genera are partly transparent and deceptive while flying in the gloom of the forest. They do not occur in strong light. *Cithaerias menander* is a transparent satyrid, also occurring in deep shade. Across its wings are faint vestiges of the leaf-vein lines that are present in some allied brown satyrids with an obliterative dead-leaf pattern. This suggests that *Cithaerias* has changed a former obliterative appearance for transparency, equally deceptive and functioning in flight as well as at rest.

E. *Mimicry* between unrelated species is a type of deception that *reduces the total number of apparent species* in a given ecological as-

sociation. This is accomplished by duplication of color, pattern, form, and behavior, at least outwardly. A mimetic group of unrelated species, consisting of two to six or more species, thus appears to be one by sharing a particular configuration.

The term "configuration" is used here to imply a connection with the Gestalt theory of learning. Each mimetic group, appearing to be a species, is a configuration or "Gestalt" to the predator, and a response of avoidance or acceptance is learned on the basis of experimental or haphazard encounters between the predator and its prey. A reduction of the number of Gestalten to be recognized can only simplify the learning process, by reducing the number of encounters needed to fix a given Gestalt in the predator's memory. Mimicry accomplishes this reduction. The learned response to a mimetic group appears in every case to be avoidance, since this kind of Gestalt happens to provide a disagreeable experience in a large proportion of possible encounters.

Mimicry observed in Panama shows, as a whole, no definite correlation with ecological niches, except that, like other adaptive coloration, it functions by day within the field of vision of species that hunt by sight. Mimetic groups seen were the following:

(1) Mutillid wasp, female, mimicked by cicindelid beetle.

(2) Winged wasps (probably a complex including models for several different mimetic groups), mimicked by certain Diptera, staphylinid beetles, euchromiid moths.

(3) Bees, mimicked by numerous Diptera.

(4) Ants, mimicked by spiders (especially attids), by cerambycid beetles, and by a mantid. Here again more than one mimetic group occurs, for the ants mimicked by the mantid are ponerids, while those mimicked by the spiders and beetles are various formicids.

(5) Lycid beetles, mimicked by euchromiid moths (*Dycladia, Correbia, Correbidia*) and by arctiids (*Lycomorphodes*, Forbes, 1939). Many other insects have been reported as lycid mimics in Asia and Africa (Carpenter, 1920).

(6) A lampyrid beetle, mimicked by an arctiid moth, *Diarhabdosia*.

(7) Danaid butterflies, mimicked by ithomiids, papilionids, and female pericopid moths.

(8) Heliconid butterflies, mimicked by ithomiids and pierids.

(9) *Papilio* (some of the *Aristolochia*-feeding species), mimicked by certain pericopid moths (Forbes, 1939).

F. *Directive* (misleading) markings and behavior. In this category I include the cases in which a part of the animal looks and acts like something it is not, while the remainder is free from any deceptive

effect, and may, indeed, be highly conspicuous. This comes under "advertisement" in Cott's (1940) work. Many of the hair-streak butterflies (Theclinae) have on the under side of the wings a showy pattern of lines and stripes, visible when they alight with wings upright. At the posterior end of the hind wings is a red or orange spot, beyond which one or two hairlike tails project. The butterfly, when at rest, constantly moves the hind wings up and down against each other, imparting a writhing motion to the spot and active wriggling to the tails. Whether this is a "false head" with "false antennae" to lure possible attackers away from the "vital" to some "nonvital" part of the body is a question on which agreement may be difficult; it is a fact that one is temporarily deceived as to the actual head of the insect, and that insectivorous birds and lizards usually respond to moving rather than motionless objects.

G. *Warning* and *display*. Deception is a minor factor in this kind of advertisement, except when the species are already deceptive through mimicry, as with the color-display and fake stinging motions of the wasplike staphylinid beetles. A more typical case of simple "warning" is the bright green and shiny black pattern of the frog *Dendrobates auratus*. This species is common in the forest of Barro Colorado, active by day and night, and a highly conspicuous animal for its size. Its poisonous skin secretion is quickly associated with the striking colors.

CONCLUSIONS

1. The kinds of adaptive coloration occurring in the rain-forest fauna are correlated with particular niches in that association. Obliterative color and pattern occur where the background is relatively homogeneous. Obliterative-ruptive patterns are correlated with a more heterogeneous background, yet one in which separate objects mean little. Object-resemblance is common in an environment composed of discrete details (leaves, twigs, thorns). Transparency occurs in shade-dwelling, large-winged insects. Mimicry reduces the apparent number of species to be recognized. Directive markings, warning, display, and the lack of adaptive coloration show no specific environmental correlation, except that species which burrow or hide out of the ordinary field of vision are unlikely to be adaptively colored in any way.

2. The total population, both of species and of individuals, occupying this faunal association appears to be much greater than would be possible in the absence of adaptive coloration, because (a) species

with obliterative, disruptive, object-imitative, or mimetic adaptations are less frequently noticed, or, if noticed, are avoided; (b) those with misleading markings or deceptive transparency may be noticed but remain relatively inaccessible; (c) those with warning coloration associated with disagreeable traits are usually avoided. To express this in figures would mean little, however, since (a) enormous groups rather than a few species are involved, (b) relatively few species-determinations of rain-forest insects from any one locality are available, and (c) the ratio between adaptively and nonadaptively colored species must be, in the nature of the case, inconstant.

Since the recent literature, very adequately cited by Cott (1940), contains evidence on nocturnal behavior, on color vision in insects and other animals, and on the selective value of various kinds of adaptive coloration, this material is omitted from the present paper, although much that is pertinent might be taken from it.

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ZOOLOGY.—*The gender of scientific names in zoology.*[1] RICHARD E. BLACKWELDER, U. S. National Museum.

The scientific names of animals, according to the International Rules of Zoological Nomenclature, must be words that are either Latin or Latinized, or that are considered and treated as such in case they are not of classic origin. Both generic and specific names are to be formed according to the principles of Latin grammar and usually have Latin endings. Specific names must bear the proper modifying relation to the generic name and may have a variable ending for this purpose. For example, adjectives must agree in gender with the generic name, substantives in apposition must be in the nominative case, and possessive substantives must be in the genitive case.

Our Zoological Code specifies these principles and some others but

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A preliminary sheet showing the two tables included in this paper was distributed at the Taxonomists' Conference on Nomenclature at the Philadelphia meetings of the American Association for the Advancement of Science on December 29, 1940. Discussion at that meeting brought out the necessity for changing Table 1. Copies of the sheet should therefore be destroyed or changed to agree with the revised version herein presented.

in general places the responsibility upon the individual to know and follow the Latin grammar.

Most research in taxonomy has been done by persons of some education, and this has very frequently meant in the past a classical one. A thorough knowledge of both Latin and Greek was considered a necessity in any education, and nearly every taxonomist of a generation or more ago had a good working knowledge of both the principles and the vocabularies of these languages. At the present time, however, it is quite possible for a student to reach the highest steps of our formal education system without a knowledge of either of these languages, and in fact few students do in these days receive a really thorough training in either of them. It has become, therefore, increasingly difficult for modern taxonomists as a group to apply uniformly the Latin rules that should govern their actions in the choice and formation of names and the use of the proper endings. And this tendency has had a marked effect on the number of mistakes made by the persons who make use of zoological names.

Perhaps the commonest problem of this sort is the question of what ending to use when a specific name is transferred from one genus to another. For example, *Cylindropsis polita* is transferred to *Osorius* and must be changed to *Osorius politus*, since *polita* is an adjective and must agree in gender with the generic name which is a noun. If the specific name were *rufipennis*, it would not change, since the masculine and the feminine endings are the same in this declension. If the specific name were *ajax*, it would not change, since it is a substantive and these are not required to agree with the generic name in gender. Situations may be much less simple than this, as in the case of *Venus*, which is feminine in spite of its masculine ending, and such combinations as: *Tenaspis angulosa* (3d decl. f. noun and 1st decl. adjective), *Tenaspis angularis* (3d decl. f. noun and 3d decl. adjective), *Eros aurora* (3d decl. m. noun and 1st decl. f. noun in appositon), *Erotides hebes* (3d decl. f. noun and 3d decl. f. noun in apposition), *Sphex latus* (3d decl. m. noun and 2d decl. m. adjective), *Microps fungi* (3d decl. f. noun and 2d. decl. m. possessive noun), *Microps minor* (3d decl. f. noun and comparative adjective of 3d decl.).

A person who is not thoroughly familiar with each of the Latin declensions frequently is at a loss to know what change in ending should be made. Fortunately a large part of our names end in the familiar *us*, *a*, *um* endings and many more in the *is*, *is*, *e*. But even when one recognizes these, what about the *ger*, *gera*, *gerum* and *ger*, *gra*, *grum* endings, the *as*, *es*, *os*, *ps*, *rs*, *or*, *x*, etc., which never change,

and the *a, e, m, is*, etc., which sometimes change and sometimes do not when the gender of the generic name changes?

Then there are a considerable number of names that defy even the Latin rules by virtue of a gender inherent in their meanings. *Venus* takes feminine specific names and *Adonis* takes masculine, in direct opposition to the usual gender of words ending as these do. Many words ending in *a* derived from the Greek, such as *Conosoma* and *Strigoderma*, retain the neuter gender which they had in that language. There is no way to recognize these words from themselves, one must simply know in advance how they are to be used.

Like many of the younger entomologists I have encountered considerable difficulty in these matters because of my lack of a sufficient knowledge of Latin grammar and vocabulary. I find that there is a strong temptation to abandon these requirements and simply use at all times the exact original form of the specific name regardless of other considerations. I believe that this *will* be the result if we continue to base our procedure on the rules of grammar of a language not well known to all the people involved, but I also believe that this would be an unfortunate occurrence and that it can be prevented by the use of a simpler set of rules.

In the writings of Col. Thos. L. Casey[2] I chanced upon a suggestion which seemed to offer hope of a better solution. Col. Casey argued as follows[3]:

> As generic and specific words are mere symbols for the designation of a species, it seems desirable that they should be withdrawn as far as possible from exceptions to general rules of grammar, and, that in this respect as least, they should be treated in the abstract as mere aggregations of letters. The rules of gender should be made uniform, so that generic symbols ending in a certain manner shall demand a certain definite and invariable gender in the specific symbol.
>
> The only course left, therefore, is to consider the generic name as a simple harmonious combination of letters, having a Latin form, constructed without absolutely essential reference to rigidly correct orthography in the language from which it may have been derived, whether Greek, Latin, or aboriginal American, and subject to constant rules of gender which shall be independent of linguistic caprice. The word may or may not have a meaning in the original language from which it is taken, although in any event, the meaning is of but little material importance.
>
> An attempt at uniformity involving a suppression of the rules of orthography, and made in a spirit similar to that which has prompted the above remarks, has recently come into quite general use—I allude to the growing custom of writing all specific names, whether proper or common, with a small initial letter. All such rules as this, which have for their object the attainment of simplicity and uniformity in scientific nomenclature, are undoubtedly very desirable.

[2] One of the most studious and prolific writers on Coleoptera of the past generation.

[3] Ann. New York Acad. Sci. 5: 307–308. 1890.

Col. Casey proposes that for generic names the endings *as*, *es*, *os*, *us*, *r*, and *o* be established as masculine, that *a*, *is*, *s* preceded by a consonant, *ys*, *e*, and *x* be feminine, and that *m* and *n* be neuter. These would be invariable, the ending itself determining the gender of the name. In using the above rule for several years I have found it very useful but have wished for a more comprehensive list and also for a similar aid in determining what endings to use on the specific name in each case. By compiling lists of names and comparing them with Latin grammars I have been able to assemble a table of endings which does seem to make it possible to determine the proper ending in any case according to set rules and with a minimum of trouble.

Generic names formed by arbitrary combinations of letters may end with any letter, as *Anzac*, *Coati*, *Arrup*, *Biat*, and *Coendou*. These names appear to be valid under Article 3 of the Rules, but their gender is not a matter to be guessed offhand by anyone except the original author. Of the above names *Anzac*, *Arrup*, and *Coendou* were originally used as masculine, *Coati* and *Biat* were used as feminine. Although in some respects it would seem proper for an author to determine the gender of a name in such cases, it will lead only to confusion, since all subsequent users of the name will be under the necessity of referring to the original article to determine the gender. In order to avoid this and to reduce the matter to a single rule that can be fitted into the above system, the following has been compiled principally from Latin usages. Generic names ending in *b*, *c*, *d*, *f*, *g*, *h*, *j*, *l*, *p*, *q*, *t*, *v*, *w*, or *z* or in *i*, *u*, or *y* shall be considered to be neuter. When we combine this rule with Casey's list, we get Table 1, in which the possible endings of genera are grouped under the appropriate genders. It will enable one to determine the gender of any generic name by it sending.

TABLE 1

Masculine	Feminine	Neuter
er, ir or, os us, ex	a, e, as, es, is, s (preceded by a consonant), x (except ex)	b, c, d, f, g, h, i, j, k, l, m, n, o, p, q, ar, ur, t, u, v, w, y, z

To determine the proper ending for the specific name one must first know whether it is a substantive or an adjective. The endings of substantives can not be changed under any circumstances, but the endings of adjectives generally must be changed if there is a change of gender in the generic name.

Adjectives can end (in the singular[4]) only with the following letters or combinations: *a, e, um, er, is, us.*[5] Names ending in these letters are likely to be adjectives but may occasionally be substantives. If one does not recognize any particular name as an adjective, resort must be had to a dictionary. However, unless such a name can be shown to be a substantive, it is best to treat it as an adjective and change its ending to agree with the generic name. For example, the name *nigrita* has been used at times as a substantive and at other times as an adjective. The derivation of the name is open to question, but much confusion can be avoided by treating it as an adjective.

In Table 2 an attempt has been made to indicate the gender of every possible ending of an adjective specific name (as herein restricted) and to show the proper endings of this name in the other genders as well. The gender of any ending in the first columns is indicated by the gender column in which the italics occur.

TABLE 2

Endings				Gende r			Example
Final Letter	Preceded by	(preceded by)	(preceded by)	Masc.	Fem.	Neut.	
a	r			er	*(e)ra*	(e)rum	rubra
a	(any other)			us	*a*	um	rugosa
e	[4]			is	is	*e*	acre
m	u	r		er	(e)ra	*(e)rum*	rubrum
m	u	(any other)		us	a	*um*	rugosum
r	e	ch		*er*	ra	rum	pulcher
r	e	n, p, s	a, e,[2] i, o, u	*er*	era	erum	tener
r	e	(any other)	a,[2] e, o, u	*er*	ra	rum	sacer
r	e	(any other)	i,[1] consonant[4]	*er*	era	erum	armiger
s	i			*is*	*is*	e	debilis
s	u[3]			*us*	a	um	rugosus

[1] Except *niger* and its compounds, and *piger*, which are *-iger, -igra, -igrum.*
[2] Except *lacer, -era, -erum* and *acer, alacer, -ris, -re.*
[3] Except *degener, -eris, -ere.*
[4] Except *volucer, -cris, -cre,* and the alternative masculines of many words, as *equester, equestris; palustor, palustris;* and *acer, acris.*
[5] Except the neuter of comparative adjectives (*majus, minus, latius,* etc.) which are herein treated as substantives.

Names with any endings other than *a, e, um, er, is, us,* must be substantives (or adjectives treated as substantives), but as noted

[4] Since the Rules specify that generic names must be in the nominative singular, the modifying adjectives must also be singular.

[5] In Latin a few adjectives with imperfect or unusual declension in the singular may end in such combinations as: *i, am, em, ar, or, as, es, us, os, ps,* and *rs.* Except for the comparative adjectives (*or, ar, us*) these generally have the same form in all genders and they are all therefore herein treated as substantives rather than adjectives. Words ending in *x* cannot properly be said to be irregular or imperfect, but, since their endings are the same in all genders, they may be omitted from the table and treated with the substantives.

above substantives may end in any letter (especially *a*, *e*, *i*, *m*, *n*, *o*, *r*, *s*, *x*). The ending of a substantive does not ever change.

The foregoing statements have been made in part as though they were principles of Latin grammar and in part as though they were suggested departures therefrom. This is exactly the case and it will be well to recapitulate the changes that are proposed. If the names of animals are considered to be symbols for species and genera rather than Latin names for them, we find ourselves at once cut off from any set of rules of orthography. Our International Code specifies that "the scientific names of animals must be words which are either Latin or Latinized, or considered and treated as such in case they are not of classic origin." Our symbols can be included in the latter category. An improvement can be made, however, over the Latin usages of gender. Since our names are symbols and no longer have a meaning of their own, they no longer possess an inherent gender. It has been customary to assign a gender to them depending on the declension to which they would have belonged in Latin, but there were exceptions due to inherent gender in the words themselves, for example *Venus* (feminine) and *Adonis* (masculine). In many cases writers have never been able to agree on the proper gender, one basing his claim on the structure of the word and the other upon its original meaning. All this could be avoided in the future by the adoption of a fixed gender for each possible ending, these being based on Latin grammar but being more comprehensive while admitting no exceptions.

The only change then is a standardization of the few variables that now exist and the addition of a few new factors to cover names which could not have existed in true Latin. The aim is uniformity in the agreement of specific names with generic names, and I believe that the proposals here made can be accepted into our present procedures without any change in the International Rules. Names will still be treated as if they were of classic origin, they will still agree grammatically with the generic name. We need only interpret the word "grammatically" to include a more rigid rule of ending than in the previous use of Latin grammar.

ENTOMOLOGY.—*New American Tingitidae (Hemiptera).*[1] CARL J. DRAKE, Iowa State College, Ames, Iowa.

This paper contains the descriptions of seven new American lace bugs, including one from Guam Island. Two of the species were intercepted at ports of entry into the United States by Federal quarantine officials; *Phatnoma ecuadoris* at New York City and *P. barberi* at San Francisco from Ecuador. The types of all the new species are in the U. S. National Museum.

Phatnoma ecuadoris, sp. nov.

Allied to *P. varians* Drake, but readily distinguishable by its wider paranota, more elevated carinae, and slenderer form. Head with seven spines, the middle pair stouter at the base than in *varians*. Antennae rather long, slender, segment III about three and one-half times as long as IV, the latter mostly black. Bucculae longer, more widely reticulated, less excavated on each side before apex and not so strongly produced downward at apex as in *varians*. Rostrum long, testaceous.

Pronotum moderately convex, coarsely pitted, tricarinate; lateral carinae more elevated, the areolae a little larger; paranota wider and more sharply angulate at the sides than in *varians*, biseriate behind, triseriate in front and quadriseriate at lateral angle; collar raised, composed of three rows of areolae. Elytra grayish brown, the enlarged, transverse nervures and some of the nervelets dark fuscous; costal area moderately broad, quadriseriate in basal fourth, thence to apex largely triseriate; subcostal are a broader, largely five areolae deep; discoidal area long, about three-fourths the length of the elytra, five areolae deep in central portion, the outer boundary raised and its nervure for about three-fourths of its length foliaceous and composed of one row of low, rectangular areolae, the inner boundary also raised, foliaceous and uniseriate for almost its entire length; sutural area brownish, without markings.

Length, 2.90 mm; width, 1.30 mm.

Holotype, male, Ecuador, collected in bananas at port of entry, New York City.

Phatnoma barberi, sp. nov.

Head black, with seven long, slender, pale-tipped spines, the front pair and median a little longer than the middle pair, the hind pair much longer, slenderer, and strongly curved forward. Bucculae long, dark brown, contiguous in front. Rostral laminae pale testaceous, subparallel; rostrum testaceous, very long, extending on venter. Legs moderately long, dark-fuscous, the tibiae and tarsi largely brown. Eyes black. Antennae dark fuscous, moderately long; segment I much stouter and twice as long as II; III long, a little more than twice as long as IV, becoming darker apically; IV darker, rather long, moderately swollen on the distal half.

Pronotum very coarsely pitted, moderately convex, dark ferruginous, shiny, tricarinate; median carina uniseriate, the areolae rather small; lateral carinae parallel, not quite extending to calli, each uniseriate, but not quite so high as median; collar distinctly raised, areolate; paranota similar in form to *P. marmorata* Champ., but not quite so wide, mostly three to four areolae

[1] Received February 5, 1941.

deep, the areolae hyaline, the hind margin pale. Scutellum exposed, small. Elytra strongly overlapping and rounded posteriorly, brown, with whitish testaceous markings and some of the transverse nervures of costal area dark fuscous; costal area broad, four areolae deep on basal and apical portions, three deep in middle, the areolae hyaline; subcostal area broad, finely reticulated, largely five areolae deep, with four, enlarged, whitish, transverse nervures; discoidal area broad, long, extending to the apical fourth of elytra, with three enlarged, whitish, transverse nervures, the nervure separating it from subcostal area raised, foliaceous, with one row of moderately large areolae, the apical margin not raised or reticulate, the inner boundary raised, uniseriate, not quite so high as outer nervure and extending posteriorly between subcostal and discoidal area. Wings slightly longer than abdomen.

Length, 2.95 mm; width, 1.25 mm.

Holotype, female, Colombia, South America, intercepted by Federal inspectors at Port of Entry, San Francisco, Calif.

This species is very distinct and not easily confused with any other member of the genus. It is about the size of *P. varians* Drake from French Guiana, but readily separated from it by the foliaceous carinae and foliaceous nervures bounding discoidal area. *P. marmorata* Champ. has a much broader costal area and is differently colored.

Tingis guamensis, sp. nov.

Moderately large, without hairs, testaceous, with inconspicuous brown markings. Head flat above, testaceous, without spines. Eyes very large, dark reddish brown. Rostrum extending almost to end of sulcus, brownish, black at apex; laminae foliaceous, pale, testaceous, becoming more widely separated posteriorly, concave within on each side on both mesosternum and prosternum, connected at apex by a low narrow ridge. Bucculae broad, testaceous, areolate, closed in front. Antennae moderately long, slender, testaceous, the apical segment brownish; segment I short, stouter and a little longer than II; III a little more than two and a half times as long as IV.

Pronotum very coarsely pitted, convex above, subtruncate, tricarinate; lateral carinae indistinct on disk, obsolete in front, fairly distinct on triangular process; median carina sharply developed and indistinctly areolate; paranota very narrow, linear, slightly broader opposite humeri, there with distinct areolae. Elytra with outer margin rounded and narrowed posteriorly, strongly overlapping and jointly rounded behind; costal area rather broad, with a transverse, fuscous band (veinlets of 6–8 areolae) near middle, mostly biseriate, triseriate in widest part, the areolae rather small; subcostal area broader, six areolae deep in widest part, the areolae small; discoidal area large, reaching a little beyond middle of elytra, eight areolae deep at widest part near middle, narrow at base and apex, the boundary nervures distinct but not prominent, nearly triangular in outline; sutural area more widely areolate posteriorly. Some veinlets of subcostal, discoidal, and sutural areas brownish to dark fuscous.

Length 3.30 mm; width, 1.50 mm.

Holotype, female, Island Guam, D. T. Fulloway.

This species belongs to the subgenus *Tingis* Fabr. and is not easily confused with its congeners.

Acalypta mera, sp. nov.

Small, elongate-ovate, grayish brown. Head black, with two short, blunt,

porrect, frontal spines. Bucculae open in front. Rostral laminae subparallel, testaceous, not meeting behind; rostrum brownish, black at apex, extending almost to hind margin of first venter. Legs dark brown, the tibiae testaceous, the tips of tarsi black. Antennae moderately long, indistinctly pilose; segment I dark brown, much stouter and nearly twice as long as II, the latter dark brown; III testaceous two and one-half times as long as IV; IV almost entirely black, shiny, fusiform.

Pronotum almost flat, very coarsely pitted, almost reticulate in appearance, distinctly areolate behind; carinae foliaceous, each uniseriate, the median slightly more elevated, the lateral carinae strongly divaricating posteriorly, extending from base of hood to hind margin of triangular process. Paranota moderately broad, with moderately large areolae, biseriate in front, uniseriate behind, the outer margins slightly rounded. Elytra with costal area uniseriate, the areolae rather large; subcostal area much wider, with four rows of confused areolae; discoidal area large, broad, about three-fourths of the length of the elytra, bounded by a costate nervure, widest for some distance at the middle, there five areolae deep, the outer margin distinctly raised and sinuate.

Length, 1.80 mm; width, 0.50 mm.

Holotype, brachypterous male, British Columbia, Canada, September 10, 1928.

Of the western species, *A. mera* is probably most closely related to *A. vandykei* Drake but is slenderer and has strongly divaricating lateral carinae. It may be also separated from *A. barberi* Drake of New York by its much smaller size, longer rostrum and paranota. In the writer's collection, a long-winged specimen of *Acalypta* from Oregon seems to be *A. mera*.

Leptopharsa papella, sp. nov.

Moderately long, broad, testaceous, with brown to dark fuscous markings. Head black, convex above, with five, moderately long, testaceous spines, the median stouter and porrect. Rostrum brownish, dark at apex, extending to middle of mesosternum; rostral channel with sides parallel on mesosternum, broader and cordate on metasternum, open behind. Body beneath brownish black. Legs slender, testaceous, the tarsi dark. Antennae slender, moderately long; segments I and II brown, the former very much stouter and a little more than three times as long; III very slender, testaceous, nearly four times as long as IV, the latter slightly enlarged and brownish black.

Pronotum convex, coarsely pitted, tricarinate, the triangular projection testaceous and reticulate; carinae foliaceous, testaceous, each uniseriate; lateral carinae strongly constricted near the middle, terminating anteriorly a little distance behind the hood; hood moderately large, inflated, slightly produced forward in front, extending backward on pronotum, the crest narrow and part of hind portion; paranota testaceous, moderately large, widest opposite humeri, there broadly angulate and three areolae deep. Elytra broad, strongly overlapping, testaceous; four or five transverse nervures of costal, two small spots in discoidal and apical veinlets of sutural areas embrowned; costal area broad, mostly biseriate, triseriate in widest part; subcostal area broader, mostly triseriate; discoidal area large, extending slightly beyond middle of elytra, there five areolae deep, rounded at apex; sutural area closely reticulated at base, more widely reticulated apically, some of the veinlets along the inner margin and in apical fourth infuscate. Areolae hyaline, iridescent.

Length, 3.30 mm; width, 1.60 mm.

Holotype, female, Ashton, Md., August 27, 1938. P. W. Oman.

This species resembles certain members of the genus *Gargaphia* Stal, in general appearance, but does not have an interrupted rostral channel. It differs from *L. velifer* (McAtee) in having a narrower paranota and costal area, smaller hood; the median carina is much less foliaceous and its dorsal margin not so sinuate.

Gargaphia valerioi, sp. nov.

Large, whitish testaceous, the pronotum black, the oblique, costate nervures of costal area black-fuscous, the margins of paranota clothed with long pale hair. Head brown, with five slender spines, the median much longer and porrect. Antennae long, beset with long, pale, bristly hairs, brown, the apical segment black; segments I and II dark brown, the former larger and two and one-half times as long as the latter: III about three and three-fourths times the length of IV, the latter long and slightly enlarged. Rostrum extending to transverse suture.

Pronotom black, convex, covered with whitish exudation, the triangular portion reticulate, whitish testaceous, tricarinate; carinae foliaceous, each uniseriate, the areolae large, the lateral carinae on disk faintly convex within, the median distinctly arched on disk of pronotum; hood rather small, narrow to crest, almost conical in form, slightly produced forward at base; paranota broad, strongly reflexed, obtusely produced, widest opposite humeri, there four areolae deep. Elytra broad, widening posteriorly, their tips separated when at rest; costal area very broad, the outer margin broadly rounded and beset with very fine, moderately long spines; subcostal area narrow, biseriate, discoidal area not reaching middle of elytra, broadest beyond middle, there six areolae deep, some of the apical nervelets embrowned; sutural area finely reticulated at base, becoming widely reticulated distally.

Length 4.65 mm; width, 1.45 mm.

Holotype (male), allotype (female), and paratype (female, broken), La Gloria, Costa Rica, altitude 900 feet, July 1931, M. Valerio. Named in honor of the collector.

This species is not easily confused with other North American members of the genus. The long hairs, shape of paranota and elytra are distinguishing characters. The lateral margins of elytra are beset with rather stiff bristly hairs, which are much shorter than the hairs on pronotum and carinae.

Corythucha omani, sp. nov.

Similar to *C. unifasciata* Champ. but distinctly smaller and with the hood not so sharply constricted and the tumid elevations of elytra more roundly inflated. Testaceous, a transverse band near base and some of the veinlets of hood, paranota, tumid elevation and sutural area and a few transverse nervures near apex of elytra infuscate. Antennae moderately long, testaceous, beset with long bristly hairs; segment I about three times as long as II; III nearly two and one-half times as long as IV; the latter swollen toward the apex and mostly dark brown. Legs brownish, the tibiae and tarsi testaceous; rostrum extending to the metasternum.

Pronotum brown, finely pitted, moderately convex, tricarinate; lateral carinae rather short, raised anteriorly, not extending forward beyond base of triangular process; median carina foliaceous, mostly uniseriate, about one-half as high as the hood, the upper margin sinuate. Hood moderately large, strongly inflated, constricted a little in front of middle, the hind portion

subglobose. Paranota large, four areolae deep, the outer margin beset with spines. Elytra distinctly narrowed posteriorly, beset with spines along the outer margins from the base to apical fourth; costal area triseriate, the areolae large and hyaline; tumid elevation plump, moderately large, dark. Wing a little longer than abdomen, whitish.

Length, 3.10 mm; width, 1.10 mm.

Holotype (male) and two male paratypes, Nogales, Ariz., October 23, 1937, P. W. Oman; allotype (female) and paratypes (male and female) Tucson, Ariz., August 1934, C. J. Drake. Named in honor of P. W. Oman, who is taking a very active interest in collecting and studying hemipterous insects.

ANTHROPOLOGY.—*Relationships of an early Indian cranial series from Louisiana.*[1] HENRY B. COLLINS, JR., Bureau of American Ethnology.

One of the most significant recent developments in Southeastern archeology has been the discovery in Kentucky, northern Alabama, and Tennessee of a nonagricultural, nonceramic, shell mound culture, the earliest thus far known in the area (Webb, 1939; Webb and Haag, 1939, 1940). The Kentucky sites that have been described are Indian Knoll and Chiggerville (Moore, 1916; Webb and Haag, 1939) on the Green River in Ohio County, and the Ward and Kirkland sites on Cypress Creek, a Green River tributary (Webb and Haag, 1940). The Alabama-Tennessee sites are situated on the Tennessee River; Lu° 86 and Ct^{v} 17, in the Wheeler Basin, have already been described (Webb, 1939), and reports on the Pickwick and Guntersville sites are in press or in preparation.

In Louisiana, Ford and Willey (1940) have recognized a similar early culture complex, the Tchefuncte, which preceded the Marksville (Hopewellian) stage. Some of the Tchefuncte sites are coastal shell middens, others are earth mounds in the interior; unlike the Kentucky sites, they all yield pottery.

The skeletal remains from these rather widely separated sites are of particular interest. Though by no means identical, the crania from Kentucky, Alabama, and Louisiana belong to the same general type, a type that differs in certain important respects from that of later inhabitants of the same areas. Measurements on Moore's Indian Knoll crania have been published by Hrdlička (1927), and the skeletal material from Chiggerville has been described by Skarland (1939). Newman and Snow are describing the skeletal remains from the Pickwick and Guntersville Basins and Snow those from the Louisiana shell middens. What I wish to do here is call attention to certain skulls

[1] Published by permission of the Secretary of the Smithsonian Institution. Received February 17, 1941.

from Pecan Island, Vermilion Parish, southern Louisiana, which I excavated in 1926 (Collins, 1927), and which, from the later archeological investigations of Ford and others, are shown to have belonged to the Tchefuncte period.[2]

The Pecan Island series has been included in Hrdlička's latest catalog (1940) along with other Louisiana crania. Since they represent a sample of the earliest known Indian population in the Gulf area, it seems desirable to separate them from the other Louisiana crania and point out briefly their relationship to other southern and eastern cranial types.

The skulls were excavated from a burial ground (no village site in evidence) in a grove of young orange trees on the property of John Copell. The skulls were undeformed, and like the associated long bones, showed no evidence of pathology. Some of the bones rested on layers of red and yellow pigment. The following objects were found associated with the burials: Chipped stone knives and projectile points; hollow bone and antler projectile points with asphaltum in lower end to hold shaft; awls made of raccoon penis bones and deer cannon bones and ulnae; clam shells filled with asphaltum; distal end of an atlatl; "boat-stone" and rectangular stones (atlatl weights); tubular shell bead; drumfish teeth; large shell vessel (*Busycon perversum*); inner whorls of conch shells; raccoon and otter penis bones, some perforated; muskrat jaws; perforated dog teeth; worked pieces of turtle shell; and worked sections of dog jaws and teeth. No pottery was found with the burials; a few sherds of crude ware from the surface may represent a later period.

In addition to the Copell place two other sites were investigated on Pecan Island. (1) A group of low burial mounds on the Veazey place yielded fragmentary bones including some skulls with slight frontal flattening and long bones showing lesions apparently produced by syphilis. Cultural material from the Veazey site in part resembled Copell (red and yellow pigment with burials; asphaltum; bone awls and socketed projectile points; tubular shell bead; worked sections of dog jaws and teeth; raccoon and otter penis bones; and muskrat jaws). But there were other objects at the Veazey site such as spool-shaped ear ornaments of sheet copper and of slate covered with copper; woven textile, potsherds of Marksville type, stone celts, disk shell beads, perforated bear teeth, imitation bear teeth in shell, large finely chipped flint knife, and worked pieces of galena and hematite—traits that are

[2] The cultural material from the site has been studied by Ford and Quimby and will be included in their report on the Tchefuncte culture.

diagnostic of the Hopewell culture, either as it exists in Ohio or in its southern manifestations, especially the Marksville of Louisiana and the Copena of northern Alabama. (2) At the third Pecan Island site, the Morgan place, were several large stratified mounds from which came skulls with pronounced fronto-occipital flattening and long bones showing evidence of syphilis. These highly deformed skulls, the nature of the mounds themselves, and the different type of pottery clearly indicated a cultural and temporal distinction between the Morgan and other sites; on the other hand, there seemed at the time no reason for separating Copell and Veazey, and I assumed them to have been contemporaneous (Collins, 1927).

Ford's later excavations in Louisiana and Mississippi and his analysis of potsherds from over 100 aboriginal sites in these States have thrown clearer light on the chronological relationship of the Pecan Island sites. Pottery analysis showed the Morgan mounds to belong to Coles Creek-Deasonville (the intermediate prehistoric culture stage in Louisiana and Mississippi) and Veazey to be somewhat earlier, since its pottery complex included Marksville sherds in addition to Coles Creek-Deasonville (Ford, 1936).

The artifacts from the Copell site, according to Ford and Quimby, are sufficiently like those from the Tchefuncte middens to be included in that complex. In some respects the Copell material is even closer to that from the Kentucky middens described by Moore (Indian Knoll) and Webb and Haag (Chiggerville and Cypress Creek). Without going into details here, I may state that the most striking and diagnostic Copell traits are also present at Indian Knoll and/or Chiggerville. The resemblances are such as to indicate a close cultural relationship, despite the considerable distance between central Kentucky and the Louisiana Gulf coast.

The exact relationship between the Copell and Tennessee-Alabama sites can not be known until we have Webb and DeJarnette's report on the Pickwick Basin excavations. However, the two sites from this area thus far described (Lu° 86 and Ct^{v} 17 in the Wheeler Basin; Webb, 1939) reveal fewer trait correspondences with Copell than do Indian Knoll and Chiggerville.[3]

In the first column of Tables 1 and 2 I have listed the means of

[3] Webb and Haag (1940) find that the Kentucky shell mound sites share a number of features with Ritchie's Lamoka Lake site in New York, for which reason they suggest that the Kentucky shell mound complex be assigned to the Archaic pattern. These resemblances, it might be pointed out, are of a general rather than specific character; few really diagnostic Kentucky traits are present at Lamoka and vice versa. The relationship between Kentucky and Lamoka seems definitely more remote than that between Kentucky and Copell.

measurements and indices of the Copell crania, calculated from the individual data given in Hrdlička's catalog (1940, pp. 434–436, 439–441). The series comprises 20 males and 13 females. One of the males listed in the catalog as Copell (No. 334223) came instead from the Veazey place and so is not included here. It might also be mentioned that the male skull in the deformed Louisiana series listed in the catalog as "Pecan Island" (No. 334251, p. 437) came from one of the Morgan mounds.

Following tabulation of the Copell means are columns showing the differences between these and the means of other southern and northern groups. The differences, whether plus or minus, are totaled and the average difference is given at the foot of the column. Measurements and indices are given separately, a necessary arrangement since two groups may show pronounced metrical differences and yet be very close indicially. The frequencies for all measurements and indices are given only for those series comprising the smallest numbers of skulls—the two Louisiana series, Chiggerville, the Lenape males, and New York females. To avoid unnecessary detail the only frequencies given for the other series are those for cranial length and index.

The groups selected for comparison are: (1) Those nearest geographically (Arkansas and other Louisiana); (2) the two culturally related Kentucky groups; and (3) those from Florida (Perico and Horrs Islands), the middle and upper Mississippi regions (Tennessee and Illinois), and the East and Northeast (Virginia, New York, New Jersey) that most closely approach Copell in skull form. The comparison brings out significant resemblances and differences with respect to cranial length and breadth, cranial height, face breadth, and orbital height.

In length and breadth of skull the Copell males stand midway between the southern and northeastern groups. They are considerably longer and with a few exceptions narrower headed than any other group from the Gulf region, though shorter and wider than the Algonkian-Iroquois type of the Northeast. The closest agreement in this respect is with western Virginia, where, as Hrdlička (1916) has pointed out, the skull form is intermediate between that of the North and South. The Virginia cranial index is identical with Copell, and the average difference of all measurements (1.98 mm) is smaller than for any other group.

The female Copell skulls are relatively much broader than the male. In this respect, and in most others, the females conform rather closely to the usual Gulf type, from which they differ only in having broader faces, somewhat broader noses, and lower and broader orbits.

Perhaps the most striking feature of the Copell crania is their great height. This is of especial interest because of the significance of this feature in America (Hrdlička, 1916, 1922, 1927, 1940; Stewart, 1940). Regarding height of the vault in the Southeast, Hrdlička (1940, p. 454) says:

> The rest of the Gulf and neighboring States [except Texas] stand out in this important respect as a unit, characterized throughout by a relatively high vault. With that of some of the Pueblos it is the highest, in crania of similar breadth and cranial index, on the North American Continent. And we do not know as yet of such a broad high-headed large human group elsewhere.

If we consider the Louisiana crania alone the situation is even more striking. In absolute height (basion-bregma) and mean height index the Copell males are exceeded slightly by the other Louisiana males, 11 in number. The combined total of all the Louisiana males shows a cranial height of 146.4 mm and a mean height index of 89.65. With the exception of two skulls from Pensacola Bay, Fla., they are higher headed than any other group from the Southeast, from the Pueblo region, Arctic, or Northeast—in fact, the highest of any human group thus far recorded. If the comparison be restricted to the six Copell males the results are much the same: two more samples of three skulls each, from Ross County, Ohio, and Indiana (Hrdlička, 1927, p. 47) equal Copell in mean height index (89.6) and the Indiana skulls slightly exceed them in absolute height (146.3 mm).

Though the Copell males have broad faces they are exceeded in this respect by most of the Floridians and by some of the Eskimo and Plains Indian groups. The face breadth of the five Copell females, on the other hand, is the largest recorded for females anywhere. The small size of the sample should be borne in mind, however. In face height, upper and total, the Copell females fall within the Southeastern range; they are consistently somewhat higher faced than the Algonkian and other Northeastern groups. For the males, measurements of total and upper facial height are available for only two and three individuals, respectively. These measurements, and the facial indices, are given in parentheses, but are not included in the average differences.

A striking feature of the Copell males is their low orbits. In this respect they stand entirely apart from the other southern Indians, while closely resembling the two prehistoric Kentucky groups and the Lenape. Their orbital height of 33.1 mm and index of 84.65 are likewise lower than the average for the Northeast where relatively low orbits prevail. Elsewhere in North America lower orbits than those of the Copell males are recorded only for the prehistoric Texas cave

dwellers, the two Kentucky series, and Manhattan and Long Islands, N. Y.

The Copell females are less pronounced in this respect, their orbits being somewhat higher, absolutely and indicially, than those of the males. However, they are still below the general average for the Southeast in absolute height, and their orbits being unusually broad, the index falls considerably below the Southeastern average. Most of the New England and other Northeastern females listed by Hrdlička (1927) have orbits that are somewhat lower in absolute height than those of the Copell females, but again the extreme orbital breadth of the latter results in a lower index.

It will be seen from Tables 1 and 2 that the Copell crania of both sexes tend to resemble the Gulf type (Florida, Arkansas, and other Louisiana) more closely in actual measurements than in indices. In contrast, the crania from Tennessee, Kentucky, Illinois, and Virginia, which are smaller in practically every dimension, are closer to Copell indicially than metrically. This is especially true of the skulls from Chiggerville and Indian Knoll, Ky. Since these are the smallest skulls thus far known east of the Mississippi, it is not surprising that there should be a sharp metrical contrast between them and the Copell crania, which in size and massiveness are above the average even for the Southeast. But despite the fact that the two Kentucky series are metrically farther removed from Copell than any of the other groups compared—with average differences of 4.39 mm and 4.01 mm for the males and 6.58 mm and 5.05 mm for the females—they are still very close indicially. This close similarity in cranial form would seem to indicate that the prehistoric Kentuckians and the Copell (Tchefuncte) people of southern Louisiana, both groups the earliest known in their respective localities and possessing a common culture, were likewise closely related physically. The great disparity in size might be explained, at least partially, on the basis of dietary differences. The food resources of the Louisiana Indians included both land and marine animals. According to present archeological evidence neither they nor the Kentucky shell mound Indians practiced agriculture. From the sea food they consumed—fish, mollusks, crustaceans—the Copell people would no doubt have received a more than adequate supply of calcium, phosphorus, and magnesium, the minerals most essential to bone development. It is known that marine fishes, oysters, crabs, and shrimps are excellent sources of these and other necessary minerals such as iodine, copper, and iron (Nilson and Coulson, 1939). As far as I am aware there is no information regarding the mineral and vitamin

content of the fresh-water mollusks and fishes of the Tennessee-Kentucky region, though deficiency in iodine, at least, may be assumed.

Newman (1939) and Snow (1940) report that the crania from the shell mounds in Pickwick and Guntersville Basins on the Tennessee River are very similar to those from Indian Knoll and Chiggerville.

> In the Pickwick Basin skeletal material there are two main types represented. The earliest stratigraphically is an undeformed dolichocranic type representing in unmixed form the southernmost extension of the general Eastern dolichocranic group, best exemplified by the so-called Northeastern Algonkins. The later intrusive deformed type links most closely with the Southeastern brachycranic group as seen in Tennessee, Arkansas, Louisiana and Florida skeletal series. . . .
>
> The dolichocranic Shell Mound group in Pickwick Basin, taken as a whole, diverges somewhat from the pooled Northeastern and East-central Algonkin series in its smaller size, relatively higher vault, and shorter vertical facial diameters. Within this group there is some evidence of a more gracile, smaller-headed variant and a more rugged, larger-headed variant. The latter group more closely resembles the various more northerly dolichocranic series, whereas the former shows close affinities to even smaller and more gracile series from Ohio County, Kentucky. These series are from Shell Mounds with pre-pottery horizons similar to the Pickwick sites. (Newman, 1939.)

The Copell people, with their low orbits and (in the males) a skull form bordering on dolichocrany, represent a still further extension into the South of what may be described as a generalized or modified Northeastern dolichocranic type. In some respects, however, such as the relatively broad skull of the females and the extreme cranial height and facial breadth in both sexes, the early Louisiana population diverges sharply from the Northeastern type and conforms to that of the Southeast. If we regard these southern features as evidence that the Copell people had already been subjected to local admixture we must assume that a brachycranic population had preceded them in the Gulf region. Of this, however, there is no evidence. On the contrary, wherever it has been possible to distinguish between earlier and later peoples in the Southeast, long heads are found to have preceded the broad heads (Newman, 1939; Snow, 1940) just as they usually have in other parts of America. Moreover, it seems unlikely that mixture with some hypothetical early population embodying the essential characteristics of the historic Gulf type should have resulted in a blend that exhibited such typical southern features as extreme cranial height and facial breadth in even more pronounced form than they are usually found today; or, on the other hand, in orbits not only much lower than those of the southern Indians but lower on the average than those in the Northeast.

It seems more likely that in the Copell crania we have a sample of an early population that, with later admixture, gave rise to the his-

TABLE 1.—COMPARISON OF COPELL AND OTHER SOUTHERN AND EASTERN CRANIA—MALES

Measurements and Indices	Louisiana[1] (Copell)	Louisiana[1] (non-Copell)	Arkansas[1]	Florida[1] (Horrs Island)	Florida[1] (Perico Island)	Tennessee[1]	Kentucky[2] (Indian Knoll)	Kentucky[2] (Chiggerville)	Illinois[2]	Virginia[2]	New Jersey[2] (Lenape)	New York[2]
	(20)	(14)	(38)	(33)	(37)	(23)	(34)	(24)	(30)	(29)	(12)	(19)
Cranial length	186.3	−4.6	−9.6	−1.4	−3.0	−6.9	−6.3	−5.2	−3.3	−2.7	+0.2	+2.9
	(20)	(14)						(24)			(12)	
Cranial breadth	141.4	+4.9	+1.4	+5.4	+4.4	−1.4	−5.6	−7.2	−2.3	−2.1	−2.5	−1.2
	(6)	(11)						(4)			(8)	
Cranial height	146.0	+0.6	−4.4	−2.1	−4.8	−2.2	−6.5	−6.5	−3.9	−3.5	−6.3	−7.5
	(6)	(11)						(5)			(8)	
Cranial module	157.3	+0.6	−3.7	+1.8	0.0	−1.9	−6.3	−5.9	−2.5	−2.6	−2.4	−1.4
	(2)	(5)						(8)			(5)	
Menton-nasion	122.5	(+9.9)	(+0.8)	(+4.7)	(+3.7)	(+2.5)	(−6.8)	(−12.2)	(+0.9)	(+4.5)	(−1.1)	(−1.3)
	(3)	(8)						(9)			(5)	
Alveolar point-nasion	73.0	(+5.1)	(+1.8)	(+4.3)	(+2.8)	(+1.7)	(−2.6)	(−3.9)	(+1.8)	(+0.7)	(−2.4)	(−0.1)
	(8)	(9)						(3)			(5)	
Face breadth	144.0	+3.1	−5.2	+3.8	+2.4	−5.1	−8.0	−6.3	−3.5	−3.3	−5.2	−3.0
	(9)	(9)						(6)			(5)	
Orbit height, mean	33.1	+3.6	+2.3	+3.1	+3.2	+0.7	−0.5	−0.6	+2.1	+0.9	+0.2	+1.2
	(9)	(9)						(7)			(5)	
Orbit breadth, mean	39.1	+2.1	+0.1	+0.8	+0.6	−0.5	−1.0	−0.5	+0.7	−0.5	−0.5	0.0
	(5)	(10)						(13)			(5)	
Nose height	54.0	−0.1	−0.8	+1.0	−1.2	−1.6	−3.1	−3.7	−0.7	−1.0	−3.1	−2.1
	(5)	(11)						(9)			(5)	
Nose breadth	26.0	+0.8	+0.5	+0.6	−0.7	−0.3	−2.2	−0.2	−0.5	+1.2	+0.5	+1.1
Average difference of measurements		2.27	4.00	2.22	2.26	2.29	4.39	4.01	2.16	1.98	2.32	2.27
	(20)	(14)	(38)	(33)	(37)	(22)	(34)	(23)	(30)	(29)	(12)	(19)
Cranial index	75.90	+4.6	+4.9	+3.5	+3.7	+2.1	+0.8	−1.6	+0.1	0.0	−1.5	−1.8
	(6)	(11)						(4)			(8)	
Mean height index	89.60	+0.8	−2.9	−2.3	−3.9	−0.4	−0.6	−1.1	−1.4	−1.0	−3.6	−5.4
	(6)	(11)						(4)			(8)	
Height-breadth index	103.50	−2.9	−4.1	−5.9	−6.7	−1.4	−0.8	+0.8	−1.3	−1.1	−2.9	−4.7
	(2)	(5)						(3)			(5)	
Facial index, total	86.25	(+2.8)	(+2.7)	(+0.8)	(+0.4)	(+4.1)	(−1.6)	(−6.1)	(+1.5)	—	(+1.3)	(−0.4)
	(3)	(7)						(3)			(5)	
Facial index, upper	50.96	(+2.3)	(+2.8)	(+1.5)	(+1.0)	(+2.6)	(+0.7)	(+0.6)	(+2.5)	(+1.3)	(−0.1)	(+0.2)
	(9)	(9)						(5)			(5)	
Orbital index, mean	84.65	+4.5	+5.6	+6.0	+6.9	+2.7	−0.3	−1.5	+3.9	+3.6	+1.6	+3.1
	(5)	(10)						(9)			(5)	
Nasal index	48.16	+1.5	+1.7	+0.2	−0.3	+0.9	−1.3	+2.2	−0.1	+3.0	+3.9	+4.0
Average difference of indices		2.86	3.84	3.58	4.30	1.50	0.76	1.44	1.36	1.74	2.70	3.80

[1] Hrdlička, 1940. [2] Hrdlička, 1927. [3] Skarland, 1939.

TABLE 2.—COMPARISON OF COPELL AND OTHER SOUTHERN AND EASTERN CRANIA—FEMALES

[1] Hrdlička, 1940. [2] Hrdlička, 1927. [3] Skarland, 1939.

TABLE 2.—COMPARISON OF COPELL AND OTHER SOUTHERN AND EASTERN CRANIA—FEMALES

Measurements and Indices	Louisiana[1] (Copell)	Louisiana[1] (non-Copell)	Arkansas[1]	Florida[1] (Horrs Island)	Florida[1] (Perico Island)	Tennessee[1]	Kentucky[2] (Indian Knoll)	Kentucky[3] (Chiggerville)	Illinois[2]	Virginia[2]	New Jersey[2] (Lenape)	New York[2]
	(13)	(16)	(52)	(35)	(60)	(37)	(26)	(13)	(39)	(28)	(22)	(18)
Cranial length	174.4	−4.3	−7.5	+2.1	+0.3	−4.5	−4.1	−1.9	−2.7	+3.1	+0.8	+2.8
	(13)	(16)						(12)				(18)
Cranial breadth	139.8	0.0	−1.4	−0.1	+1.3	−4.0	−9.0	−9.0	−4.9	−4.3	−8.2	−4.8
	(2)	(13)						(6)				(16)
Cranial height	137.0	+1.1	−0.2	−4.3	−0.7	−0.2	−5.8	−5.0	−1.5	−1.5	−6.7	−6.1
	(2)	(13)						(6)				(16)
Cranial module	151.5	−2.7	−4.1	−3.8	−0.9	−4.1	−7.4	−6.2	−4.0	−1.9	−5.7	−3.8
	(5)	(9)						(6)				(9)
Menton-nasion	116.4	−2.2	−0.8	+1.6	+3.3	−0.5	−11.5	−8.9	−0.3	−0.9	—	−4.1
	(5)	(13)						(6)				(13)
Alveolar point-nasion	70.8	−0.2	+0.5	+1.2	+0.8	−0.9	−7.2	−4.5	−2.7	−3.1	−2.6	−1.6
	(5)	(11)						(2)				(11)
Face breadth	138.6	−6.7	−9.8	−4.4	−1.9	−12.4	−14.1	−12.6	−12.1	−7.4	−12.1	−7.2
	(9)	(10)						(6)				(15)
Orbit height, mean	33.7	+1.1	+1.6	+1.6	+1.1	+0.1	−1.2	−0.6	+0.5	−0.7	+0.2	0.0
	(9)	(10)						(7)				(15)
Orbit breadth, mean	39.0	−0.9	−1.6	−0.4	−0.5	−2.5	−2.5	−1.2	−1.1	−1.6	−1.0	−1.2
	(5)	(13)						(6)				(15)
Nose height	51.4	−1.4	−0.7	−0.8	−1.3	−1.9	−5.4	−3.6	−2.0	−1.4	−2.5	−1.1
	(5)	(11)						(5)				(15)
Nose breadth	26.8	−1.5	−1.4	−2.5	−1.8	−1.6	−4.2	−2.0	−0.9	+0.2	−1.3	−0.1
Average difference of measurements		2.01	2.24	2.07	1.26	2.97	6.58	5.05	2.97	2.37	4.11	2.96
	(13)	(16)	(52)	(35)	(60)	(37)	(26)	(12)	(39)	(28)	(22)	(18)
Cranial index	80.11	+2.1	+2.8	−0.9	+0.7	−0.2	−3.1	−4.7	−1.5	−3.8	−5.0	−3.9
	(2)	(13)						(6)				(16)
Mean height index	86.35	+3.3	+3.2	−0.9	0.0	+3.2	+0.9	+0.6	+2.1	+0.1	−1.4	−2.6
	(2)	(13)						(6)				(16)
Height-breadth index	97.35	+0.6	+1.4	−1.9	−0.5	+3.6	+2.9	+3.9	+3.1	+2.6	+1.7	−0.4
	(4)	(6)						(1)				(9)
Facial index, total	84.60	+2.6	+6.1	+2.6	+3.3	+6.7	0.0	(+3.2)	+6.3	+3.9	—	+1.4
	(4)	(9)						(1)				(11)
Facial index, upper	51.80	+1.5	+3.8	+1.7	+0.8	+3.7	+0.1	(+0.9)	+1.6	+0.6	+1.4	+1.1
	(9)	(10)						(4)				(15)
Orbital index, mean	86.45	+4.8	+7.8	+5.0	+4.1	+6.3	+2.6	−1.1	+3.9	+1.9	+2.9	+2.9
	(5)	(11)						(5)				(15)
Nasal index	52.10	−0.8	−2.0	−4.1	−2.2	−1.2	−2.7	+0.1	+0.4	+1.9	+0.2	+0.9
Average difference of indices		2.24	3.87	2.44	1.66	3.56	1.76	2.08	2.70	2.11	2.10	1.89

[1] Hrdlička, 1940. [2] Hrdlička, 1927. [3] Skarland, 1939.

toric Gulf type. Since the males on the whole show closer physical affinities with Kentucky, Tennessee, Virginia, Illinois, and the Northeast than with the Southeast, it would seem that the origin of the early Gulf type should be sought in that direction. The Copell people should, apparently, be regarded as the southernmost and in some respects most divergent and specialized representatives of a once widespread Indian type east of the Mississippi, a long-headed and rather high-headed type that in one form or another was characteristic of the earliest known culture horizons in the Northeast, Kentucky, Tennessee, and northern Alabama.

The affinities of the later brachycranic type in the Southeast seem to lie in the opposite direction, probably in eastern Mexico, as Hrdlička (1922, pp. 117, 131) has suggested. Though the paucity of comparative data for Mexico prevents demonstration of this point, it appears not unlikely that herein may lie the explanation of the process of brachycephalization that seems to have occurred generally throughout the Southeast. The brachycranic Gulf type would seem best explained as a blend between the earlier coastal population, of Northeastern origin, and a later broad-headed strain which probably entered the Southeast from Mexico. Such a hypothesis finds support in the evidence of strong cultural influences from Mexico, most of which, as Phillips (1940) shows, have been received in relatively late prehistoric times. Artificial cranial deformation was doubtless one of the culture traits thus introduced from Mexico. The custom was not practiced in the Northeast nor by the early southern groups which we have been considering (Stewart, 1940; Snow, 1940). It was, however, present in Mexico, Middle America, and Peru from the earliest known times, and it was evidently from this direction that it later spread to the Southeast and Mississippi Valley.[4]

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[4] The fact that cranial deformity is so rarely encountered in peninsular Florida would seem to preclude the possibility that the custom had reached the Southeast by way of the Antilles.

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PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

THE ACADEMY

43D ANNUAL MEETING

The 43d Annual Meeting of the Washington Academy of Sciences was held in the Assembly Hall of the Cosmos Club, January 16, 1941, with 46 members present. President EUGENE C. CRITTENDEN called the meeting to order at 9:40 P.M. The minutes of the 42d Annual Meeting were presented and approved as published in the JOURNAL.

Report of the Corresponding Secretary

The Corresponding Secretary, FREDERICK D. ROSSINI, submitted the following report on the membership and activities of the Academy:

During 1940, there was a total of 59 persons (31 resident and 28 nonresident) elected to membership. Of these, 43 accepted membership, 10 declined, and 6 did not reply. Of those accepting membership, 8 were elected in recognition of their work in plant pathology, 6 in entomology, 5 in forestry, 4 in biology, 2 in agronomy, 2 in medicine, 2 in zoology, 2 in physics, and 1 each in botany, chemistry, cytology, dentistry, geology, helminthology, horticulture, parasitology, physiology, plant physiology, meteorology, and soil science.

Because of their retirement from active work, 12 members (6 resident and and 6 nonresident) were placed on the "retired" list to enjoy all the privileges of membership without further payment of dues. Resignations were accepted from 14 members in good standing (10 resident and 4 nonresident). One nonresident member permitted his membership to lapse through nonpayment of dues for two years and was dropped from the rolls.

During 1940, there occurred the deaths of the following 12 members (6 resident and 6 nonresident):

GEORGE C. MATSON, Tulsa, Okla., January 3, 1940.
FREDERICK G. TRYON, Washington, D. C., February 15, 1940.
DAVID M. MOTTIER, Bloomington, Ind., March 25, 1940.
CYRUS ADLER, Philadelphia, Pa., April 7, 1940.
THOMAS A. GROOVER, Washington, D. C., April 20, 1940.
FREDERICK E. FOWLE, Washington, D. C., April 23, 1940.
FRANCIS R. HAGNER, Washington, D. C., July 7, 1940.
WILLIAM BOWIE, Washington, D. C., August 28, 1940.
WILLIAM LASH MILLER, Toronto, Canada, September 1, 1940.
EDWARD B. MEIGS, WASHINGTON, D. C., November 5, 1940.
RAYMOND PEARL, Baltimore, Md., November 17, 1940.
WALTER J. YOUNG, Fredericksburg, Va., November 23, 1940.

On January 1, 1941, the membership of the Academy was distributed as follows:

	Resident	*Nonresident*	*Total*
Regular	417	131	548
"Retired"	31	13	44
Honorary	3	14	17
Patrons	—	3	3
TOTAL	451	161	612

On that date there were 34 vacancies in the resident and 19 in the nonresident list. As a result of elections to membership made by the Board of Managers on January 10, 1941, and of nominations presented to the Board on that day, there are potentially only about 20 vacancies in the resident and 14 in the nonresident list.

During the period from February 9, 1940, to January 10, 1941, the Board of Managers held seven meetings, with an average attendance of 17 persons. During the year, the Board authorized the appointment by the President of the following special committees:

1. Committee to consider revising the bylaws with regard to the two Nonresident Vice-Presidents: H. L. CURTIS (chairman), C. THOM, P. C. WHITNEY. Work completed.

2. Committee to consider the printing contract for the JOURNAL: F. G. BRICKWEDDE (chairman), H. G. AVERS, R. W. BROWN, C. L. GAZIN, J. H. KEMPTON, R. J. SEEGER, and J. A. STEVENSON. Work completed.

3. Committees on awards for scientific achievement, for 1940: AUSTIN H. CLARK, General Chairman.

For the biological sciences: A. H. CLARK (chairman), F. O. COE, J. M. COOPER, H. A. EDSON, E. A. GOLDMAN, I. T. HAIG, C. F. W. MUESEBECK, H. W. SCHOENING, G. STEINER, and A. WETMORE.

For the engineering sciences: F. M. DEFANDORF (chairman), C. H. BIRDSEYE, H. L. CURTIS, H. G. DORSEY, H. N. EATON, A. C. FIELDNER, H. C. HAYES, G. W. MUSGRAVE, and W. N. SPARHAWK.

For the physical sciences: O. H. GISH (chairman), A. K. BALLS, F. S. BRACKETT, W. E. DEMING, H. E. MCCOMB, F. L. MOHLER, W. T. SCHALLER, J. H. TAYLOR, O. R. WULF, and E. G. ZIES. Work of the committees completed.

4. Committee to consider the provision of a meeting place for the Acad-

emy when the Cosmos Club moves: The President (chairman), the Corresponding Secretary, and the Chairman of the Committee on Meetings. Work not completed.

5. Committee to consider the archives of the Academy: N. R. SMITH (chairman) and F. D. ROSSINI. Work completed.

6. Committee to consider societies for affiliation with the Academy: F. M. SETZLER (chairman), R. E. GIBSON, and R. R. SPENCER. Work not completed.

7. Committee of Tellers to count the ballots on three amendments to the bylaws: H. N. EATON (chairman), B. J. MAIR, and R. S. JESSUP. Work completed.

8. Committee to consider problems of the JOURNAL relating to the number of copies to be printed and of back numbers and volumes to be bought and sold: the Custodian of Publications (chairman), the Senior Editor, and the Treasurer. Work completed.

On motion it was voted to accept the Corresponding Secretary's report and to place it on file.

Report of the Recording Secretary

The Recording Secretary, FRANK C. KRACEK, presented the following report:

The 43d year of the Academy began with the 296th meeting and ended tonight with the 302d meeting. All the seven meetings of the year were held in the Assembly Hall of the Cosmos Club.

The 296th meeting was held on February 15, 1940. An illustrated address was given by GEORGE GAYLORD SIMPSON of the Department of Paleontology, American Museum of Natural History in New York City, on the subject *Mammals and land bridges*. The address was subsequently published in the JOURNAL. Attendance 123.

The 297th meeting, which was held on March 21, 1940, was memorable for being the first presentation by the Academy of awards for scientific achievement. Three awards were presented on this occasion, in the fields of biological, engineering, and physical sciences.

The award in Biological Sciences was received by HERBERT FRIEDMANN of the U. S. National Museum, in recognition of his researches and publications in the field of *Ornithology*. Dr. FRIEDMANN was introduced by ALEXANDER WETMORE, Assistant Secretary of the Smithsonian Institution.

The award in Engineering Sciences was presented to PAUL A. SMITH of the U. S. Coast and Geodetic Survey, in recognition of his contributions to knowledge of the *Ocean bottom along the eastern coast of the United States*. The recipient was introduced by LEO OTIS COLBERT, Director of the U. S. Coast and Geodetic Survey.

The award in Physical Sciences was received by WILMOT H. BRADLEY, of the U. S. Geological Survey, in recognition of his contributions on the *Oil shale of the Green River formation in Wyoming*. Dr. Bradley was introduced by GERALD F. LOUGHLIN, Chief Geologist of the U. S. Geological Survey.

Certificates of award were presented by EUGENE C. CRITTENDEN, President of the Academy. The recipients responded by brief addresses concerning their work. Attendance 83.

The 298th meeting was held on April 18, 1940. The Academy was addressed on the subject *Science and Democracy* by WALDEMAR KAEMPFERT, Science Editor of the New York Times. Attendance 82.

The 299th meeting was held on October 17, 1940. W. F. G. SWANN, Mem-

ber of the Academy and Director of the Bartol Research Foundation of the Franklin Institute spoke on *Laws of nature*, especially emphasizing the extent to which the laws of physics are creations of the mind. Attendance 78.

The 300th meeting was held on November 28, 1940. The subject *Human side of the census* was discussed by VERGIL D. REED, Assistant Director of the Bureau of the Census. Attendance 87.

The 301st meeting was held as a joint meeting with the Botanical Society of Washington on December 19, 1940. An illustrated address on the *Conquest of the land* was delivered by W. C. LOWDERMILK, Member of the Academy and Assistant Chief of the U. S. Soil Conservation Service. The speaker emphasized the role man's use of the land plays in its erosion and illustrated his theme by lantern slides of depleted land in a number of historic areas. Attendance 92.

The 302d meeting was held on January 16, 1941. The address was given by the retiring President of the Academy, EUGENE C. CRITTENDEN, Assistant Director of the National Bureau of Standards, who spoke on the *Progress in the measurement of light*, summarizing the steps that have been taken in recent years toward the establishment of a logical basis for the precise measurement of light, and the relation of such measurements to the usefulness of light under various conditions of vision. Attendance 59.

On motion it was voted to accept the Recording Secretary's report and to place it on file.

Report of the Treasurer

The Treasurer, HOWARD S. RAPPLEYE, presented the following financial statement of the accounts of the Academy:

CASH RECEIPTS AND DISBURSEMENTS

RECEIPTS:		
From back dues	$ 150.00	
From dues for 1940	2491.00	
From dues for 1941	130.00	
From subscriptions for 1939	2.50	
From subscriptions for 1940	593.28	
From subscriptions for 1941	274.80	
From sales of JOURNALS	113.15	
From sales of directory	1.40	
From payments for reprints	357.71	
From interest on deposits	86.92	
From interest on investments	896.50	
Total receipts	5097.26	
Cash balance January 1, 1940	1018.49	
Cash received from Interborough bond	25.00	
To be accounted for		$6140.75

DISBURSEMENTS:

For Secretary's office, 1939		$ 66.45	
For Secretary's office, 1940		449.99	
For Treasurer's office, 1940		223.04	
For JOURNAL printing, 1939		236.91	
For JOURNAL printing, 1940		2314.23	
For JOURNAL reprints, 1939		25.66	
For JOURNAL reprints, 1940		485.29	
For illustrations, 1940		391.21	
For Custodian and Subscription Manager		41.77	
For JOURNAL office, 1939		20.77	
For JOURNAL office, 1940		241.97	
For Meetings Committee, 1939		121.30	
For Meetings Committee, 1940		274.55	
For dues returned to retired members		10.00	
Bank debit memos, as follows:			
Dues, 1940	$ 0.25		
Dues, 1941	.80		
Subscriptions, 1940	.75		
Subscriptions, refunded	3.15		
Interest on investment	25.22		
		30.17	
Deposited in savings account		86.92	
Total disbursements		5020.23	
Cash balance December 31, 1940		1120.52	
Total accounted for			$ 6140.75

RECONCILIATION OF BANK BALANCE

Balance as per cash book, December 31, 1940		$1120.52	
Bank Balance, American Security & Trust Co. per statement of December 31, 1940		1098.34	
Receipts not deposited		120.80	
		1219.14	
Checks outstanding, not cashed			
No. 170	$21.50		
669	8.00		
670	9.66		
671	2.20		
672	5.63		
673	7.34		
674	44.29	98.62	
Balance		$1120.52	

Check No. 170 listed as outstanding was issued in May, 1934, but has not been cashed.

INVESTMENTS

409	shares stock of Washington Sanitary Improvement Co., par value $10 per share, cost	$4090.00
20	shares stock Potomac Electric Power Co., 6 per cent Pref., cost	2247.50
*4	certificates Corporate Stock of the City of New York, 1 for $500 and 3 for $100, cost	800.00
**1	Bond of Chicago Railways Co., No. 1027, interest at 5 per cent, due 1927; par value $1000 less $250; cost	713.87
1	real-estate note of T. Q. Donaldson (No. 6 of 12) dated June 26, 1937 (extended for 3 years); interest 5 per cent, cost	1000.00
2	real-estate notes of Yetta Korman et al., dated October 5, 1938, for 3 years. (No. 7 of 37 for $500, and No. 8 of 37 for $500); cost	1000.00
3	real-estate notes of Ell & Kay Bldg. Investment Co., dated October 15, 1938, for 3 years. (No. 75 of 165 for $2000, No. 83 of 165 for $1000, and No. 101 of 165 for $1000); interest at 5 per cent; cost	4000.00
	Butler notes—property at 1707 L Street NW., bought in by note holders—Academy's share 4/250ths; interest amounting to $20.00 received in 1940; cost	2000.00
		15,851.37
	Deposited in savings account, American Security & Trust Co.	8496.86
	Cash book balance December 31, 1940	1120.52
	Total Assets	$25,468.75

Total Assets Dec. 31, 1939	$25,474.80
Total Assets Dec. 31, 1940	25,468.75
Net change for 1940	$−6.05

* The certificates of the Corporate Stock of the City of New York were received in exchange for the Interborough Rapid Transit Co. bond as a result of the unification of the Interborough Rapid Transit Co. and the Manhattan Railway Co. which have both passed to the public ownership of the City of New York. The amount of $10.00 was received in interest on the Interborough bond and $25.00 was paid on the investment.

** The bond of the Chicago Railways Co. was not paid upon maturity due to the expiration of franchise and failure of the Legislature to enact continuing legislation; interest has been paid to date under the authority of the Courts, and $250 has been paid on the principal since maturity.

ALLOTMENTS

	Allotted	*Expended*
Secretary's office	$ 450.00	$ 449.99
Treasurer's office	225.00	223.04
JOURNAL	2500.00+receipts 1341.44=3841.44	3432.70***
Meetings Committee	350.00	274.55***
Custodian and Subscription Manager	120.00	41.77
Membership Committee	10.00	——
Executive Committee	10.00	——

Report of the Auditing Committee

The Auditing Committee, H. E. MCCOMB (chairman), L. V. BERKNER, and F. S. BRACKETT reported:

"Your committee appointed to audit the accounts of the Treasurer of the Washington Academy of Sciences for the year 1940 submits the following report:

"The Treasurer's records of receipts and expenditures as shown in his account books and included in his report have been examined and found correct.

"All vouchers have been examined and found to be correct and properly approved.

"The balance sheets submitted by the bank and the securities listed in the Treasurer's report have been examined. The statement of the assets of the Academy was found correct.

"The records of the Treasurer's office have been carefully and systematically kept, thus greatly facilitating the work of the auditing committee.

"The auditing committee congratulates the Treasurer on the manner in which he has carefully conducted his office during his term of office."

It was moved to accept the reports of the Treasurer and the Auditing Committee and to place them on file. By vote it was so ordered.

Report of the Board of Editors

The Board of Editors, C. LEWIS GAZIN, JAMES H. KEMPTON, and RAYMOND J. SEEGER, reported as follows:

Volume 30 for the year 1940 consisted of 12 issues amounting to 548 pages, 12 pages less than Volume 29 but equaling Volume 27. It contained 67 original articles. Of these 34 were by members of the Academy and 33 were communicated. Leading papers of general interest were obtained for 6 issues. Original papers were illustrated by 64 linecuts and 28 halftones. In several instances papers contained illustrations in excess of the number allowed and these were paid for either by the author or by an interested member. Space in volume 30 was distributed as follows:

2 papers in Anthropology	totaling	22.9 pages or	4.2 per cent
2 papers in Biochemistry	totaling	13.9 pages or	2.5 per cent
20 papers in Botany	totaling	122.6 pages or	22.4 per cent
5 papers in Chemistry	totaling	39.4 pages or	7.2 per cent
7 papers in Entomology	totaling	46.3 pages or	8.5 per cent
2 papers in Geology	totaling	33.2 pages or	6.1 per cent
2 papers in Ichthyology	totaling	8.5 pages or	1.6 per cent

*** Bills outstanding, not paid, at end of year (estimated): JOURNAL, $327.72; Meetings Committee, $46.25.

1 paper in Malacology	totaling	2.0 pages or	0.4 per cent
1 paper in Mycology	totaling	6.5 pages or	1.2 per cent
1 paper in Ornithology	totaling	12.5 pages or	2.3 per cent
5 papers in Paleobotany	totaling	29.6 pages or	5.4 per cent
6 papers in Paleontology	totaling	57.1 pages or	10.4 per cent
13 papers in Zoology	totaling	71.8 pages or	13.1 per cent

9 Obituaries with 7.2 pages, Scientific Notes and News with 0.9 page, and Index with 6.9 pages occupied together 15.0 pages or 2.7 per cent. The Proceedings of the Academy and affiliated societies occupied 60.4 pages, distributed as follows:

The Academy	22.3 pages
Anthropological Society	1.2 pages
Botanical Society	6.5 pages
Chemical Society	2.8 pages
Geological Society	14.0 pages
Philosophical Society	13.6 pages

The amount allocated by the Academy to printing, engraving, distribution and for reprints of the JOURNAL was $2200.00 plus receipts. The total of receipts from the JOURNAL, including subscriptions, sale of back numbers, charges to authors for excess illustrations, corrections and reprints collected during 1940 is $1341.44, giving a total income to the JOURNAL for printing, etc., of $3541.44.

The total cost of printing, engraving, and distribution and of reprints of the JOURNAL for 1940 was $3453.30. The unexpended balance is $88.14.

The amount allocated by the Academy to expenses of the Editor's office was $300.00. The amount expended by this office was $262.74, leaving an unexpended balance of $37.26. The total unexpended balance from printing, etc., and from the Editor's office is $125.40.

The report of the Board of Editors was accepted and ordered placed on file.

Report of the Custodian and Subscription Manager of Publications

The following report was submitted by the Custodian and Subscription Manager of Publications, W. W. DIEHL:

In this, the first year of the office, the duties have been chiefly that of custodianship concerned first with locating the stocks, then with their inventory and storage. There is appended herewith a summarized inventory of stocks on hand.

All the stocks, except those of the JOURNAL, Volumes 22 to 29 inclusive, at Menasha, Wis., are now stored in Washington. Since March 16 when certain stocks previously kept in Baltimore, Md., were moved to Washington there have been no storage costs.

The campaign for new subscribers to the JOURNAL planned for initiation in September was necessarily deferred until late in December because the unforeseen shortage of current stocks at that time precluded any possibility of filling additional subscriptions for Volume 30. This shortage in Volume 30 has been most helpfully alleviated through the aid of the President and of certain other members of the Academy in obtaining copies by personal solicitation. Immediate demands have, therefore, been met thus far.

Because of the deferment of the campaign for new subscribers the amount actually expended for the necessary work, chiefly postage and correspondence, was $47.77 leaving an unexpended balance of $72.23.

Nonmember subscribers in the United States	93
Geological Society of Washington	23
Nonmember subscribers in foreign countries	52
	168

SUMMARY OF INVENTORY OF SALABLE STOCKS OF PUBLICATIONS OF THE WASHINGTON ACADEMY OF SCIENCES ON DECEMBER 31, 1940

PROCEEDINGS OF THE WASHINGTON ACADEMY OF SCIENCES:

Vols. 1 to 13, incl.	50 sets complete

JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

Vols. 1 to 15, incl.	1 set complete
	7 sets incomplete
Vol. 16	28 complete
17	33 complete
18	28 complete
19	27 complete
20	23 complete
21	68 complete
22	47 complete
23	46 complete
24	40 complete
25	86 complete
26	77 complete
27	51 complete
28	30 complete
29	24 complete
30	9 complete

A miscellaneous collection of odd numbers of the Proceedings, the JOURNAL, Red Books, and special publications relating to World War No. 1 is also on hand.

By vote the report of the Custodian and Subscription Manager of Publications was accepted and placed on file.

Report of the Tellers

The report of the Tellers, GEORGE W. VINAL (chairman), J. W. MCBURNEY, and W. G. BROMBACHER was read by the Corresponding Secretary. The following officers were declared elected:

President	AUSTIN H. CLARK
Secretary	FREDERICK D. ROSSINI
Treasurer	HOWARD S. RAPPLEYE
Board of Managers	FRANK H. H. ROBERTS, JR.
	FERDINAND G. BRICKWEDDE
	HENRY B. COLLINS, JR.

The Corresponding Secretary read the list of nominations for Vice-Presidents submitted by the affiliated societies as follows:

Philosophical	HAROLD E. MCCOMB
Biological	ERNEST P. WALKER
Chemical	RAYMOND M. HANN
Entomological	AUSTIN H. CLARK

National Geographic...	ALEXANDER WETMORE
Geological.....	JOSEPH T. PARDEE
Medical.....	FRED O. COE
Historical.....	ALLEN C. CLARK
Botanical.....	MELVIN C. MERRILL
Archiological.....	ALEŠ HRDLIČKA
Washington Engineers..	PAUL C. WHITNEY
Electrical Engineers....	HARVEY L. CURTIS
Mechanical Engineers..	WALTER RAMBERG
Helminthological.....	JESSE R. CHRISTIE
Bacteriological.....	LELAND W. PARR
Military Engineers.....	CLEMENT L. GARNER
Radio Engineers.....	JOHN H. DELLINGER

By vote of the Academy, the Recording Secretary was instructed to cast one ballot for the list as read. This was done and the Vice-Presidents were declared duly elected.

Report of the Committees on Awards for Scientific Achievement

The President announced that the Committee on Awards for Scientific Achievement reported as follows:

The Subcommittee for Biological Sciences reported no nomination for the year 1940.

The Subcommittee for the Engineering Sciences recommended that a certificate of award be conferred on—

HARRY DIAMOND, Principal Physicist in the Radio Section of the National Bureau of Standards, for his work in the *development of methods and apparatus for the "blind-landing" of aircraft, in the development of methods and apparatus for obtaining meteorological data from appropriately equipped balloons sent into the atmosphere and in the development of an automatic weather-reporting station.*

The Subcommittee for the Physical Sciences recommended that a certificate of award be conferred on—

FERDINAND G. BRICKWEDDE, Chief of the Cryogenic Laboratory of the National Bureau of Standards, for his work in *taking part in the discovery of Deuterium, in determining the physical properties of the various isotopic forms of the hydrogen molecule, and in establishing a working temperature scale for the range 14° to 83°K.*

As business from the floor, remarks were made by L. B. TUCKERMAN concerning the lack of care exercised by some members in marking their ballots, particularly that portion in which preference is expressed by a numerical choice for election by the Hare system. Remarks were made also by R. E. GIBSON.

President CRITTENDEN announced the appointment of NATHAN R. SMITH as Archivist for the Academy, to serve for 3 years.

President CRITTENDEN, after thanking the officers and committees who served with him during the year, appointed Past Presidents C. E. CHAMBLISS and CHARLES THOM to escort President-elect CLARK to the chair. After a short address President CLARK declared the meeting adjourned at 10:40 P.M.

FRANK C. KRACEK, *Recording Secretary.*

366TH MEETING OF THE BOARD OF MANAGERS

The 366th meeting of the Board of Managers was held in the Library of the Cosmos Club on Friday, February 7, 1941. President CLARK called the meeting to order at 8:10 P.M., with 15 persons present, as follows: A. H. CLARK, F. D. ROSSINI, H. S. RAPPLEYE, N. R. SMITH, W. W. DIEHL, F. H. H. ROBERTS, JR., F. G. BRICKWEDDE, H. B. COLLINS, JR., R. M. HANN, M. C. MERRILL, H. L. CURTIS, L. W. PARR, C. L. GARNER, and, by invitation, F. M. SETZLER and F. C. KRACEK.

The minutes of the 365th meeting were read and approved.

President CLARK announced the following appointments: Senior Editor of the JOURNAL, for 1941, J. H. KEMPTON; Member of the Board of Editors of the JOURNAL, for 1941, 1942, and 1943, G. A. COOPER; Associate Editor of the JOURNAL, representing the Biological Society, for 1941, 1942, and 1943 H. A. REHDER; Associate Editor of the JOURNAL, representing the Geological Society, for 1941, 1942, and 1943, EDWIN KIRK; Associate Editor of the JOURNAL, representing the Botanical Society, for 1941, 1942, and 1943, CHARLOTTE ELLIOTT; Members of the Executive Committee for 1941 (in addition to the President, Secretary, and Treasurer), H. L. CURTIS and J. E. GRAF; to the Committee on Monographs, for 1941, 1942, and 1943, C. L. GAZIN and F. C. BISHOPP; to the Committee on Membership for 1941, F. C. KRACEK (chairman), W. G. BROMBACHER, W. F. FOSHAG, C. F. W. MUESEBECK, J. H. STEWARD, P. A. SMITH and L. E. YOCUM.

The Executive Committee, A. H. CLARK, chairman, presented the following proposed budget, with estimated receipts, for 1941:

Proposed Budget for 1941

Secretary		$ 450.00
Treasurer		225.00
Custodian and Subscription Manager of Publications		120.00
Committee on Meetings		350.00
Committee on Membership		10.00
JOURNAL:		
For printing, engraving, mailing, reprints	$3100.00*	
For clerical assistance to the Senior Editor	240.00	
For postage and miscellaneous expenses	60.00	3400.00
Total regular budget		4565.00
Publication of the Directory of the Academy for 1941		350.00
Grand Total		$4915.00

Estimated Receipts for 1941

Membership dues for 1941	2900.00
Membership dues for previous years	100.00
Interest and Dividends	1083.42
Subscriptions to the JOURNAL	855.80
Total	$4939.22

* Does not include services to be charged to, and paid for by, authors or their sponsors.

The Board approved this budget for 1941.

The Executive Committee recommended that the President appoint a committee of two persons, one to be the Treasurer, to survey the Academy's investments and deposits and to make appropriate recommendations to the Executive Committee.

The Committee on Membership, F. C. KRACEK, chairman, presented nominations for membership for five persons, all resident.

The Board considered individually and duly elected to membership the eight persons (five resident and three nonresident) whose nominations had been presented on January 10, 1941.

The Committee to Consider Societies for Affiliation with the Academy, F. M. SETZLER, chairman, recommended that the Committee be dissolved and that its existing assignment to investigate several societies for affiliation be abandoned, because the Committee felt that any Society desirous of affiliating with the Academy should present its request to the Academy on its own initiative. The Board approved this recommendation to dissolve the Committee and abandon its assignment.

The Secretary presented the following information with regard to changes in membership since the last meeting of the Board: Deaths, none; acceptances to membership, 11; retirements, 1; resignations, 3. The status of the membership, as of February 7, 1941, was as follows:

	Regular	*Retired*	*Honorary*	*Patrons*	*Total*
Resident.....	415	33	3	0	451
Nonresident.....	125	14	14	3	156
Total.....	540	47	17	3	607

The Secretary reported receipt of two nominations for Vice-Presidents of the Academy for 1941: F. M. SETZLER, to represent the Anthropological Society of Washington; W. A. DAYTON, to represent the Washington Section of the Society of American Foresters. The Board elected Messrs. SETZLER and DAYTON to be Vice-Presidents of the Academy for 1941 to represent the Societies indicated.

The Board authorized the President to appoint a Committee to Consider the Publication of a Directory of the Academy for 1941.

The meeting adjourned at 9:30 P.M.

303D MEETING OF THE ACADEMY

The 303d meeting of the Academy was held jointly with the Philosophical Society of Washington in the Assembly Hall of the Cosmos Club at 8:15 P.M. on Thursday, February 20, 1941, with President A. H. CLARK presiding. H. E. MCCOMB, Vice-President of the Academy representing the Philosophical Society, introduced the speaker, P. W. BRIDGMAN, Hollis Professor of Mathematics and Natural Philosophy at Harvard University, who delivered an address entitled *The changing position of thermodynamics.*

Professor Bridgman pointed out that thermodynamics was formulated at a time when there was no knowledge or experimental control of the details of atomic or molecular processes, reexamined the fundamental concepts of energy and entropy, and indicated what is their present status.

There were about 180 persons present. The meeting adjourned at 9:30 P.M. for a social hour.

FREDERICK D. ROSSINI, *Secretary.*

ANTHROPOLOGICAL SOCIETY

The Anthropological Society of Washington at its annual meeting held January 21, 1941, elected the following officers for the ensuing year: President, FRANK M. SETZLER; Vice-President, JULIAN H. STEWARD; Secretary, REGINA FLANNERY; Treasurer, T. DALE STEWART; Members of the Board of Managers, GEORGE S. DUNCAN, WILLIAM N. FENTON, HERBERT KRIEGER, RUTH UNDERHILL, WALDO R. WEDEL.

A report of the membership and activities of the Society since the last annual meeting follows.

Membership:	
Life members	2
Active members	39
Associate members	12
Total	53

The members elected during the year were: ANDREW J. KRESS, active member, and WILLIAM H. GILBERT, associate member. Lost through death was CYRUS ADLER, an active member of long standing.

The Treasurer's report is as follows:

Funds invested in Perpetual Building Association (interest for last half of 1940 not included)	$1542.36
21 shares Washington Sanitary Improvement Co. (par value $10 per share)	210.00
2 shares Washington Sanitary Housing Co. (par value $10 per share)	200.00
Cash in bank	647.45
Credit with American Anthropological Association	5.00
	$2604.81
Bills outstanding:	
To American Anthropological Association	$ 75.00
Total	$2529.81
Total as of 1/15/40	2354.36
Increase	$ 175.45

The supply of the following numbers of the American Anthropologist, old series, is now completely exhausted: Vol. 1, nos. 1–3; vol. 3, no. 1; vol. 4, 1–4; vol. 5, nos. 1, 2, 4; vol. 9, no. 2.

Papers presented before the regular meetings of the Society were as follows:

January 16, 1940, 690th meeting, JOHN M. COOPER, *The Gros Ventres, a Plains Indian theocracy.*

February 20, 1940, 691st meeting, FREDERICK W. KILLIAN, *Cultural determinants of the law.*

March 19, 1940, 692d meeting, W. H. GILBERT, *Eastern Cherokee life and culture.*

April 16, 1940, 693d meeting, HENRY B. COLLINS, JR., *Some problems of Eskimo prehistory*, the address of the retiring president.

October 15, 1940, 694th meeting, WILLIAM N. FENTON, *The place of the Iroquois in the prehistory of America.*

November 19, 1940, 695th meeting, L. S. CRESSMAN, *Early cultures of south-central Oregon.*

December 17, 1940, 696th meeting, F. H. DOUGLAS, *White influence in Indian art.*

REGINA FLANNERY, *Secretary.*

GEOLOGICAL SOCIETY

580TH MEETING

The 580th meeting of the Society was held at the Cosmos Club, January 10, 1940, President J. T. PARDEE, presiding.

Informal communications.—M. I. GOLDMAN compared pits in eroded pebbles of diorite porphyry and sandstone from the Henry Mountains, Utah, with similar phenomena in the granite of Corsica; and reviewed a number of theories for their origin.

Program.—W. S. BURBANK: *An area of pseudo-landslide topography in the San Juan Mountains, Colorado.* A so-called landslide topography covering 5 to 6 square miles in the Red Mountain mining district was described, and evidence presented to show that the topography is mainly the result of differential abrasion by a mountain glacier along a zone of faulted and highly altered rocks.

The mining district lies along the northwest border of a large volcanic basin of subsidence. Zones of step-faulting and alteration along this edge of the basin provided a zone of weakness followed by the main drainage valley and by one of the trunk glaciers of the Wisconsin stage. The ice of the trunk glacier was moving parallel to the closely spaced faults and fissures, and as a result of differences in resistance to abrasion between altered and unaltered rocks, the surface was abraded into a series of troughs and ridges, and typical roche moutonée.

Small débris slides or avalanches sliding directly across these corrugations after the glacial period shattered some of the narrower and weaker ridges, partly covered them, and generally masked the true nature of the post-Wisconsin topography.

It was shown that previous interpretations of the extent of landsliding were untenable, (1) because much of the so-called landslide surface was glaciated and highly sculptured bedrock along the channel of the trunk glacier, and (2) because at many places numerous shafts and tunnels driven during mining operations were in solid bedrock and had failed to encounter conditions expectable according to the landslide interpretation.

L. W. CURRIER: *Geologic features of Lowell quadrangle, Massachusetts.*

F. W. LEE: *Contouring bedrock in a glaciated region by seismic methods.*

581ST MEETING

The 581st meeting of the Society was held at the Cosmos Club, January 24, 1940, President J. T. Pardee, presiding.

Program.—D. F. HEWETT: *The appraisal of metal reserves.*

R. J. ROBERTS: *Mercury deposits of the Bottle Creek district, Nevada.*

E. N. GODDARD: *Manganese deposits of the Philipsburg district, Montana.*

582D MEETING

The 582d meeting of the Society was a joint meeting with the Washington Academy of Sciences, at the Cosmos Club, February 15, 1940, the President of the Academy, E. C. CRITTENDEN, presiding. President J. T. PARDEE, of the Geological Society, introduced the speaker.

Program.—GEORGE G. SIMPSON: *Mammals and land bridges.* (Published in this JOURNAL 30: 137–163. Apr. 15, 1940.)

583D MEETING

The 583d meeting of the Society was held at the Cosmos Club, February 28, 1940, President J. T. PARDEE, presiding.

Informal communications.—R. W. BROWN reviewed *The Mizpah coal field, Custer County, Montana,* by F. S. PARKER and DAVID A. ANDREWS, and *Relationship between floras of type Lance and Fort Union formation,* by ERLING DORF, in their bearing on the Cretaceous-Paleocene boundary problem in the Rocky Mountain region.

Program.—L. W. STEPHENSON: *Summary of faunal studies of the Navarro group of Texas.*

JULIA GARDNER: *The general relationships of the Midway fauna.*

W. W. RUBEY and K. J. MURATA: *Chemical evidence bearing on origin of a group of hot springs.* A compact group of thermal springs 2½ miles north of Auburn, Lincoln County, Wyo., just east of the Idaho line, discharges water and gas through more than a hundred vents. The mean annual temperature of the region is about 5°C., but the water ranges from 20° to 60°C. The total discharge of water is estimated at 2.4 liters per second (38 gallons per minute) and that of gas at 0.86 liters per second under standard conditions of temperature and pressure.

The springs rise through old travertine deposits at the edge of valley fill and along a sharp anticline formed during "Laramie" folding. No igneous rocks are exposed nearby, but Auburn lies only a short distance south and east of the extensive Tertiary and Quaternary volcanics of Idaho and Yellowstone Park.

For preliminary study, two water samples, one from a hot and the other from a relatively cold spring, and two gas samples, likewise from a hot and a cold spring, were collected and analyzed.

The two water samples are very similar in composition but the hotter one is less concentrated with all components other than dissolved carbon dioxide and hydrogen sulphide. The large amount (about 3,000 p.p.m.) of sodium chloride in both samples is probably derived from salt beds in Jurassic rocks nearby. Small amounts of boron, arsenic, and ammonium compounds, substances commonly exhaled from volcanic fumaroles, are present in both waters.

Carbon dioxide is the predominant constituent of both gas samples, and appreciable amounts of hydrogen sulphide are also present. The sample of cooler gas contains more nitrogen and oxygen than the hotter one. The ratio of carbon dioxide to hydrogen sulphide is essentially the same in both samples. These two gases are common as volcanic emanations and characterize later phases of volcanism.

Quantitative relationships of water and gas composition and of temperature in these springs seem to call for a significant contribution (about 5 per cent) of steam from an underlying magma, such as Allen and Day found necessary to explain the hot springs of the Yellowstone. Magmatic steam containing minor amounts of carbon dioxide, hydrogen sulphide, and volatile compounds is conceived as condensing upon contact with a cool moderately saline ground water charged with atmospheric gases. This would account for cool, relatively concentrated water from some vents and hot, less concentrated water from others, for cool gas rich in nitrogen and oxygen from some vents and hot gas rich in carbon dioxide and hydrogen sulphide from others. Estimates of heat dissipated from these hot springs lead to the conclusion that a small Quaternary intrusion, several cubic miles in volume, along a

preexistent fracture zone but reaching no nearer to the surface than a mile or two, could explain all the observed phenomena.

584TH MEETING

The 584th meeting of the Society was held at the Cosmos Club, March 13, 1940, President J. T. PARDEE, presiding.

Program.—E. L. STEPHENSON: *Geophysical and geological investigations of the Casper Mountain chromite deposit, Wyoming.* The Casper Mountain chromite deposit is located on the summit of Casper Mountain in Natrona County, Wyo., 11 miles by road south of the city of Casper. A magnetometer survey of the deposit was made by the Geological Survey in 1938–39, when 8,281 stations were occupied with an Askania vertical variometer. Later in 1939, under the program of strategic minerals investigations, the Bureau of Mines sampled the deposit by trenching and diamond drilling, and the Geological Survey prepared detailed topographic and geologic maps and core logs. The program included 7,432 feet of sampling trenches and 3,624 feet of inclined diamond drill holes.

The deposit consists of a nearly vertical, roughly tabular body of chromite-bearing talcose schist 2,500 feet long and 100–450 feet wide, and several nearby smaller bodies. As shown by drilling, the depth of the schist exceeds 500 feet. The chromite occurs in the schist as irregular lenses and bands of small crystals and as disseminated small crystals. The surrounding rocks are quartz-monzonite, pegmatite, metadiorite, amphibolite, and quartz-mica schist. It is thought that the talcose schist and associated rocks occur as roof pendants in the quartz-monzonite.

Strong characteristic magnetic anomalies occur over the chromite-bearing schist, and were used to outline the main schist body as well as to select advantageous sites for diamond drill holes and sampling trenches. Laboratory studies of the rock samples later were used to make more complete interpretations of the magnetic anomalies. Owing apparently to an excess of iron in the chromite molecule, the Casper Mountain chromite is found to be much more paramagnetic than ordinary chromite, some of the specimens closely approximating magnetite in magnetic permeability. No evidence has so far been found of magnetite associated with the chromite in the talc schist, unless some of the most strongly magnetic specimens are to be regarded as highly chromiferous magnetites rather than unusually magnetic chromites. Specimens selected in the field as samples of magnetite were found on analysis to contain 13 per cent or more of Cr_2O_3.

No attempt was made to predict from the magnetic anomalies the amount of chromite in the schist. However, a close agreement was found between the shape and dip of the main schist body as predicted from the magnetometer measurements and as determined by drilling and trenching.

S. B. HENDRICKS: *Base exchange and properties of clays.*

585TH MEETING

The 585th meeting was held at the Cosmos Club, March 27, 1940, President J. T. PARDEE, presiding.

Program.—EARL INGERSON: *Fabric criteria for distinguishing pseudoripple marks from ripple marks.*

R. H. JAHNS: *Postglacial flood history of the Connecticut River in Massachusetts.*

T. A. HENDRICKS: *Structure of the western part of the Ouachita Mountains, Oklahoma.*

586TH MEETING

The 586th meeting was held at the Cosmos Club, April 10, 1940, President J. T. PARDEE, presiding.

Informal communications.—W. J. WOODRING reported that fossils of three different ages are found in a tar deposit in the Santa Maria district, California.

C. F. STEWART SHARPE reported on a proposed field conference on buried organic matter under Piedmont soils at Spartanburg, S. C., April 24, 1940.

Program.—G. R. MANSFIELD: *The role of fluorine in phosphate deposition.* In earlier studies of phosphate deposition attention has centered on the accumulation of phosphorus. Here it is shown that some agent, probably fluorine, is necessary to render the phosphate insoluble enough to be preserved through geologic ages. Although fluorine is steadily supplied to the oceans by the weathering and erosion of rocks containing fluorine-bearing minerals, additional large supplies are furnished from time to time by volcanism. It appears significant in this connection that volcanic products accumulated in great quantity in proximity to the regions where the principal phosphate deposits of the United States were laid down and at the time when these deposits were formed. Thus it is thought that volcanism, as a source of fluorine, may have been an indirect though determinative factor in their origin. Volcanism and unconformities are no doubt related to deep-seated causes within the earth. The principal phosphate deposits of the United States lie above unconformities of greater or less extent.

J. G. BROUGHTON: *Structural comparison of pre-Cambrian and Paleozoic rocks in northwestern New Jersey.* The area studied includes a portion of the most northwesterly of the pre-Cambrian gneiss ridges, as well as the New Jersey extension of the Pennsylvania slate belt (Martinsburg). Field relations indicate that the gneisses have developed their structures as a result of primary flowage and that the ridges are elongate domes which pitch to the southeast. Sander diagrams indicate that the lineation is the "b" axis.

The slate belt has been divided into a northern area in which the structures are identical with those described from Pennsylvania. South of this is another area in which fracture cleavage is the dominant structure. The writer believes that this cleavage has been developed as a result of stresses attendant on thrust faulting and that in its strongest development it has become almost a new flow cleavage. Yielding of quartz during the formation of cleavages is discussed with Sander diagrams.

R. H. SARGENT: *Problems in the production of topographic maps.*

587TH MEETING

The 587th meeting was held at the Cosmos Club, April 24, 1940. President J. T. PARDEE, presiding.

Informal communications.—TAISIA STADNICHENKO reported a publication of the Biogeochemical Laboratory of the Russian Academy of Science giving analyses of coals and marine organisms showing concentrations of rare elements. C. S. Ross discussed chalcedony fillings in modular masses from Madison, Oreg.

Program.—C. B. HUNT: *Mode of emplacement of stocks in the Henry Mountains, Utah, and its significance in the interpretation of laccoliths.*

T. P. THAYER: *Chromite deposits of the Strawberry Range, Oregon.* The Strawberry Range in Oregon is eroded from an east-west anticline connecting the Ochoco and Blue Mountains. The chromite deposits occur in two main belts of ultramafic rocks intruded into ancient crystalline and Mesozoic sedimentary rocks exposed in the central portion of the range.

Chromite has been mined east of Canyon City, where it occurs in comparatively fresh unsheared ultramafic rocks in which the original mineralogic and textural features are preserved. Planar and linear structures are commonly present, and are best shown in the chromite deposits. The borders of the ultramafic mass are pyroxenitic, and the chromite deposits occur as irregular lenses in the less pyroxenitic and more dunitic central portion.

The Cr_2O_3 content of the chromite ranges from 33 to 52 per cent and is apparently not the same in any two deposits. Serpentinized dunite most commonly forms the matrix of the ore, which is probably of early magmatic origin. In places dikes of gabbro and related pegmatite cut the chromite and enclose angular fragments of ore. The gabbro seems to have been altered by the agencies that serpentinized the ultramafic rocks, and therefore probably antedates the serpentinization.

About 20,000 tons of chromite, a quarter of which was high-grade ore, have been shipped from the district. Most of the readily accessible deposits of high-grade chromite have been mined out, and future production will be predominantly of low-grade concentrating ore containing from 15 to 30 per cent of chromic oxide. The indicated reserve is about 80,000 tons of ore, and with sufficiently high prices, probably 200,000 tons of concentrating ore can be mined from known deposits.

W. C. LOWDERMILK: *Notes on erosion in North Africa.*

588TH MEETING

The 588th meeting of the Society was held at the Cosmos Club, November 27, 1940, President J. T. PARDEE, presiding.

Informal communications.—J. J. FAHEY reported on two rare minerals in the Green River deposits of western Wyoming—shortite and bradleyite, the latter a new mineral.

Program.—W. E. POWERS: *Multiple glaciation of Mauna Kea, Hawaii.*

P. S. SMITH: *Trends of Alaska mineral production.*

W. T. SCHALLER: *A photographic technique for emphasizing mineral relations in hand specimens.*

589TH MEETING

The 589th meeting of the Society was held at the Cosmos Club, December 11, 1940, President J. T. PARDEE, presiding.

Program.—J. T. PARDEE: *Unusual currents in Glacial Lake Missoula.*

48TH ANNUAL MEETING

The 48th Annual Meeting was held immediately following the 588th regula meeting. The reports of the secretaries, treasurer, and auditing committee were read and approved.

Officers for the year 1941 were then elected, as follows:

President: J. B. REESIDE, JR.
Vice-Presidents: L. H. ADAMS, W. W. RUBEY.
Treasurer: ALICE S. ALLEN.
Secretary: W. S. BURBANK.
Council: D. A. ANDREWS, G. A. COOPER, JULIA GARDNER, EARL INGERSON, K. J. MURATA.

The Society nominated J. T. PARDEE to be a Vice-President of the Washington Academy of Sciences for the year 1941.

ROLAND W. BROWN, *Secretary.*